DOCUMENT RESUME

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ANIMAL SCIENCE, INCLUDING INSTRUCTION IN AGRICULTURAL MECHANICS, CAREERS, LEADERSHIP, AND SUPERVISED OCCUPATIONAL EXPERIENCE.

Missouri State Dept. of Education, Jefferson City. Agricultural Education Section.; Missouri Univ., Columbia. Dept. of Agricultural Education.

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Developed and reviewed by a committee of 16 teachers, the state supervisory staff, and the teacher education staff, this curriculum guide is for vocational agriculture teacher use with ninth grade students interested in agricultural occupations. Some objectives for this 1-year course in animal science are--(1) to develop competencies in agricultural occupations, (2) to develop appreciation for the significance of the animal industry, (3) to understand livestock production and marketing, (4) to develop fundamental knowledge and skills in agricultural mechanics, (5) to discover career opportunities in agriculture, (6) to develop leadership, and (7) to apply classroom learning. Included are sections on careers, leadership, supervised occupational experience, animal science, production agriculture, and agricultural mechanics. Each unit contains objectives, references, suggestions for student motivation, a subject outline, the recommended teaching procedure, and a summary. Supplementary materials include 59 student handouts and 112 pages for transparencies. (DM)

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SEP 20 1967
c. 1

Vocational Agriculture
Missouri

Mr. Harris

ED 022840

ANIMAL SCIENCE

Including Instruction in Agricultural Mechanics, Careers, Leadership, and Supervised Occupational Experience

State Department of Education
Agricultural Education Section

University of Missouri
Agricultural Education Department

VT001081

1081

MEMORANDUM

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FOREWORD

~~F O R W A R D~~

The concept of Vocational Education in Agriculture has changed from a farmer training program to a program which has the responsibility of establishing educational programs for persons interested in all agricultural occupations. This has provided a challenge in curriculum development for Vocational Agriculture personnel.

This curriculum guide has been prepared to help local instructors develop a course of study for all students interested in Agriculture.

The guide includes a course outline, suggested teaching procedures and illustrative materials. Each instructor should adapt this material to fit the local situation.

A committee of sixteen Vocational Agriculture instructors used the first draft of this material as an instructional program for one year. The experience and evaluation of these instructors have been very valuable in preparing the final draft for this publication.

I want to take this opportunity to express sincere appreciation to this committee and their administrators for making it possible for them to make a contribution to this state-wide curriculum for Vocational Education in Agriculture.

HUBERT WHEELER
Commissioner of Education

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COURSE OF STUDY

Careers I

Leadership I

Supervised Occupational Experience I

Animal Science

Agricultural Mechanics I

Introduction To The Course

ANIMAL SCIENCE

The next several pages contain information considered to be essential to using this book effectively. Understanding this information should be beneficial in helping find information, purchasing materials and fitting the course to the school schedule. The section, How to Use This Book, should be especially valuable to teachers.

Course Description

This introductory course in agriculture gives special attention to: (1) applications of science in the livestock industry and (2) developing beginning skills in agricultural mechanics. Students will investigate career opportunities in agriculture and consider their own career choice. A unit on leadership includes practice with parliamentary procedure and encourages students to set high, though realistic, goals for themselves.

It is expected that students will learn by doing, out of class, through a farming program or some other type of experience program to be supervised by the teacher.

Objectives

1. To encourage interested youth to develop competencies needed in agricultural occupations.

2. To help students to appreciate the significance of the animal industry.

3. To help students understand some of the basic principles of livestock production and marketing.

4. To help students develop fundamental knowledge and skills in agricultural mechanics including the areas of arc welding, small gasoline engines, woodworking, farm service center, painting and tool sharpening.

5. To encourage youth to discover some of the opportunities for careers in agriculture.

6. To encourage youth to begin the process of matching their capabilities with those demanded by various occupations.

7. To further the development of leadership abilities and a proper sense of civic responsibility.

8. To foster a sense of belonging among farm youth.

9. To help farm youth see that things learned at school have application in the real world they know at home.

Time Allotment

	Days
Careers I	10
Leadership I	15
Supervised Occupational Experience I	25
Animal Science	45
Electives for Production Agriculture	15
Agricultural Mechanics I	45
Exams, Assemblies, etc.	25
Total	180

SUGGESTED CALENDARIZED COURSE OF STUDY

(Numbers in parentheses indicate number of days allotted.)

Week		Lost Days*
1	S.O.E.** Lesson 1 (2) and 2 (2)	1
2	S.O.E. Lesson 2 (3); Leadership Lesson 1 (1)	1
3	Leadership Lesson 2 (1) and 3 (3)	1
4	Animal Science: Intro. Lesson (2); L. S. Selection (3)	
5	L. S. Selection (4)	1
6	L. S. Selection (4)	1
7	S.O.E. Lesson 3 (3) and 4 (2)	
8	S.O.E. Lesson 4 (1), 5 (1) and 6 (1), Elect. Prod. Agr.(2)	
9	Elect. prod. Agr. (4)	1
10	Agr. Mech. (4)	1
11	Agr. Mech. (5)	
12	Agr. Mech. (4)	1
13	Agr. Mech. (2), S.O.E. Lesson 7 (3)	
14	S.O.E. Lesson 7 (3) Animal Breeding (2)	
15	Animal Breeding (4)	1
16	Animal Breeding (3) Leadership Lesson 4 (2)	
17	Leadership Lesson 5 (1) and 6 (3)	1
18	Leadership Lesson 7 (4)	1
19	Animal Nutrition (4)	1
20	Animal Nutrition (4) S.O.E. Lesson 7 (1)	
21	Producing Swine (4)	1
22	Producing Swine (5)	
23	Producing Swine (5)	
24	Producing Swine (1) Agr. Mech. (3)	1
25	Agr. Mech. (5)	
26	Agr. Mech. (4)	1
27	Agr. Mech. (3) S.O.E. Lesson 7 (1)	1
28	Careers Lesson 1 (3) and 2 (2)	
29	Careers Lesson 3 (3) and 4 (2)	
30	Elect. Prod. Agr. (4)	1
31	Elect. Prod. Agr. (4)	1
32	Elect. Prod. Agr. (1) Agr. Mech. (3)	1
33	Agr. Mech. (4)	1
34	Agr. Mech. (4)	1
35	Agr. Mech. (4)	1
36	S.O.E. Lesson 7 (2)	3
	Total	25

* Holidays, examinations, etc.

** Supervised Occupational Experience

CALENDARIZED COURSE OF STUDY

Week **Lost Days**

1______________________________
2______________________________
3______________________________
4______________________________
5______________________________
6______________________________
7______________________________
8______________________________
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35______________________________
36______________________________

How To Use This Book

The form and style of this book differ from curriculum materials that have been prepared previously for vocational agriculture. It is hoped that teachers will soon become accustomed to it and that the writer's ideas will be readily communicated.

This introductory part is to explain what is included in later sections and to offer some suggestions which may help in using the materials most effectively.

THE MAJOR DIVISIONS:

There are five major divisions (units) following the introductory section: Careers I, Leadership I, Supervised Occupational Experience I, Animal Science and Agricultural Mechanics I. Tab dividers separate each division, and printed on each divider is a table of contents and list of objectives for that unit.

Animal Science is further divided into four subunits. The unit divider indicates the beginning pages for the subunits.

Using this book with success requires above all else that introductions to the units and subunits be read with care and well ahead of the time teaching is to start. It is here one finds objectives which are indicative of the scope and depth of learning recommended. Perhaps the most important category in these introductions is the one on getting ready for the unit or subunit. References and materials needed are included as are advance arrangements which need to be made such as preparing for a field trip.

The unit on agricultural mechanics, prepared by Dr. Curtis R. Weston and Richard Linhardt, does not coincide exactly in format to the other units. There are two reasons. First, a great deal of material on teaching agricultural mechanics has been distributed during the past several years and Missouri teachers have become accustomed to its format. Also, those preparing this unit felt that the format used for other units was not so appropriate where much of the learning involves acquisition of mechanical skills.

Fifteen days have been allotted to "Electives for Production Agriculture." It is anticipated that teachers will want to give careful thought to using this time to greatest advantage with respect to their local class situation.

THE LESSON PLANS:

Lesson plans include objectives, references, motivation, outline, procedures and summary. There should be little difficulty in using these if one understands the purpose of each.

Objectives. Specific objectives have been written for each lesson and these are considered to be most crucial items. If a teacher agrees with the objectives, then the problem is simply one of "How can I best accomplish them?" Procedures included here should help. So will the many good ideas of imaginative teachers.

An effort has been made to achieve consistency among objectives. Lesson objectives are intended to contribute to unit objectives which in turn contribute to the objectives which have been determined for the course. In Animal Science there is also a set of subunit objectives.

References. The instructional material needed for each lesson is listed under this heading including page numbers where appropriate. Complete bibliographical data is not listed with the lesson since the source listing which follows may be used for ordering materials not already in the departmental library. Transparencies and handouts which are included with the lessons are only listed there and on an order form from the Teaching Aids Fund.

Motivation. Motivational ideas have been written for each lesson, subunit and unit. Teachers may find these suggestive of even better ideas which are appropriate for their own class. Making the lesson meet personal needs of as many students in the class as possible is one of the best motivational techniques. Successful teachers are conscious of the continual need for re-motivation to maintain interest throughout a lesson.

Outline. Instead of a list of questions or problems for class study, an outline of lesson content has been prepared. Its purpose is to help teachers realize what subject matter students should learn and to what degree of depth.

Procedures. Procedures are written to suggest activities and other means of accomplishing the lesson objectives. These generally relate to items in the outline, but they are not always in the same order. More procedures have been listed than time will permit using in many cases. Teachers will often think of even more efficient activities for accomplishing lesson objectives. Of course they should use them.

It is hoped that teachers will readily learn to make a transition when reading the procedures. Instructions for teachers and suggested questions and discussion items to be used with students are often found within the same paragraph. The instructions are generally quite concise: "do this", "discuss", "show the transparency." Questions are always to be considered suggestive of those to ask students. Discourse, too, is intended to be suggestive of discussion ideas or a discussion approach.

Summary. A section is reserved for a summary. It seems almost impossible for anyone except class participants to decide how to summarize what was learned in a lesson. Teachers may want to list suggestion here. One might ask, "What have we learned in this lesson?" Sometimes students may be asked to write a brief summary and of course there are other ways to reinforce the learnings accomplished in the lesson.

THE PAGE NUMBERING SYSTEM:

Each of the five major units is numbered separately. Pages available from the Teaching Aids Fund as handouts for the classes have the letter "H" in parenthesis beneath the page number. If the page is available as a transparency a "T" appears under the page number. Every page bears the unit title in the upper inside corner.

GENERAL SUGGESTIONS:

It is strongly recommended that teachers prepare a calendarized course of study. Furthermore, it is recommended that they stay with it. This will often require leaving out parts of units and lessons. Such adjustments are much preferred to simply failing to finish the course when the year is over. The sample furnished here may serve as a guide and it is believed to be workable for many schools without adjustments.

It is recommended that a file drawer for additional illustrative material and notes be kept. Organizing this file around subject matter areas will permit storing materials to be used in this course and the other courses in agriculture. Frequently a particular item to be stored may have certain pages useful here and other pages suitable for more advanced work. Filing by subject matter area will simplify finding materials. Making notations in the margins of lessons will remind teachers of items that have been stored.

SOURCE LIST

I. Books

CAREERS I

An Introduction to Agricultural Business and Industry, Weyant, Hoover, McClay. The Interstate.

An Introduction to Agricultural Business and Industry -- Teacher's Guide, Weyant, Hoover, McClay. The Interstate.

LEADERSHIP I

Official Manual, Future Farmers of America, Future Farmer Supply Service.

A Guide to Parliamentary Practice, Henderson and Rucker. The Interstate.

SUPERVISED OCCUPATIONAL EXPERIENCE I

Farming Programs for Students of Vocational Agriculture, Hammonds and Binkley. The Interstate.

ANIMAL SCIENCE

American Standard of Perfection (1 copy)

Animal Science, Ensminger. The Interstate.

Census of Agriculture (Missouri), U.S. Bureau of Census.

Farm Business Planning Guide, Bulletin Mailing Room, University of Missouri, Columbia.

Improving Animals Through Breeding - Scrambled Book, Vo. Ag. Service, 434 Mumford Hall, Urbana, Illinois.

Introduction to Breeding Farm Animals, Winters. John Wiley & Sons.

Livestock and Poultry Production, Bundy and Diggins. Prentice-Hall.

Reproduction of Farm Animals, Bulletin 305, Mailing Room, Cornell University, Ithaca, New York.

AGRICULTURAL MECHANICS I

Arc Welding Lessons, J.F. Lincoln Arc Welding Foundation.

All About Small Gas Engines, Purvis. Goodheart Wilcox Co. Inc. Chicago.

The Farm Shop, Wakeman and McCoy. Macmillan Co.

Farm Welding, Parker. McGraw Hill.

General Theories of Operation, Briggs and Stratton, MIlwaukee.

Repair Insturction II -- Lab Manual, Briggs and Stratton, Milwaukee.

Shopwork on the Farm, Jones. McGraw Hill.

II. Other Publications

CAREERS I

"Vocational Agriculture Interest Inventory", The Interstate.

SUPERVISED OCCUPATIONAL EXPERIENCE I

Crop, livestock and permanent record books for Missouri, The Interstate.

ANIMAL SCIENCE

"Breed Study and Identification Kit" (4 or 5 for class). The Interstate.

"Catalog of Equipment Plans for Livestock Equipment", Extension Agricultural Engineering Department, Columbia, Missouri.

"Catalog of Swine Building and Equipment Plans", Extension Agricultural Engineering Department, Columbia, Missouri.

"Dairy Bull Unified Score Card", American Guernsey Cattle Club, Peterborough, New Hampshire 03458.

"Dairy Cow Unified Score Card", American Guernsey Cattle Club, Peterborough, New Hampshire 03458.

"Poultry Breed Pictures", ($7.50), Watt Publishing Company, Mount Morris, Illinois.

Pictures and related literature from breed associations. See MU Guide 2906 for list of associations.

"Profitable Pork Production in Missouri" C734, Bulletin Mailing Room, University of Missouri, Columbia.

"Sample Dairy Herd Improvement Record", Alfred Lane, 126 Eckles Hall, Columbia, Missouri.

"Understanding Your DHIA Records", Alfred Lane, 126 Eckles Hall, Columbia, Missouri. Also an accompanying set of slides.

III. Slides

ANIMAL SCIENCE

AS 65 Slides, Color. Set of 112 slides at $16.80 plus postage. Harold L. Kooser, Director, Visual Instruction Service, Iowa State University, Ames.

CAREERS I

LESSONS:	Days	Page
1. The Agricultural Industry and You	3	5
2. Considering Modern Agriculture	2	11
3. Some Career Opportunities in Agriculture	3	21
4. Preparing For a Career	2	25
Total	10	

OBJECTIVES:

1. To become aware of the extensiveness of the agricultural industry.
2. To investigate the future of agriculture.
3. To consider some of the specific career opportunities in agriculture.
4. To make a tentalive career choice and develop plans for career preparation.

MOTIVATION:

Careers are so extremely important in the lives of people. Unfortunately, many persons who could perform at much higher levels have moved aimlessly from one job to another. The purpose of this unit is to encourage students to begin thinking seriously about their occupational future and to begin making realistic plans for achieving career success.

GETTING READY FOR THIS UNIT:

1. Reference Materials
   An Introduction To Agricultural Business and Industry. (The Teacher's Guide to this book will be helpful too.)
   "Vocational Agriculture Interest Inventory"
2. Movies: *

   Source: Communications Department
   119 Whitten Hall
   Columbia, Missouri 65201

		Minutes
"The Welding Operator"		10
"A Step Ahead"	Color	12½
"Planning Your Career"		16
"Opportunities In Agriculture	Color	30
"Vocations In Agriculture"	Color	15
"Dynamic Careers Through Agriculture"	Color	28
"Choosing Your Occupation"		10
"The Dairy Industry		10
"Finding the Right Job"		10
"Finding Your Life Work		20
"How To Investigate Orations"		11
"Journalism"		10

* Plan to show two or three of these as this unit is studied.

EVALUATION:

Give brief objective tests occasionally.

Appraise students' career plans to see how realistic, yet challenging they seem.

Careers I

Lesson 1. The Agricultural Industry and You 3 days

OBJECTIVES:

1. To obtain a general understanding of the term "agricultural industry."
2. To undergo a self-evaluation in order to find out whether an agricultural career might be appropriate and whether our aptitudes and interests suggest that certain kinds of work in agriculture might be more suitable than others.

REFERENCES:

An Introduction to Agricultural Business and Industry, pages 3 - 9

"Vocational Agriculture Interest Inventory"

		Page
Handout:	"Studying Yourself"	8
Transparencies:	"Some Characteristics of High School Students Concerning Occupations"	9

MOTIVATION:

What decisions will you be making someday that will be more important than the choice of your life's work? To what extent does one's job determine: where he lives, who his friends are, what kind of clothes his wife wears, how his children will fare in school and his personal happiness. What else is affected by the kind of work one does?

We will be studying about you and about agricultural careers for the next several days. Your being here indicates you are interested in agriculture. Perhaps many of you will find the kind of life work that suits you best in the broad field of agriculture.

OUTLINE:

A. The agricultural industry is much broader than farming.
   1. Some aspects serve farmers with production needs.
   2. Others help process, distribute and market his products.
   3. Still others are not associated with farming at all.

B. There is a great range of occupations included in the agricultural industry.
   1. From unskilled to professional
   2. From farming to a great variety of non-farm endeavors

C. It is normal for young high school students to be very concerned about occupations.

D. Farm boys and agricultural students have a head start in agricultural careers. Much of this would likely be wasted in other careers.

E. There is a great deal of difference among us in our likes and dislikes. We should learn about our own preferences and consider these when considering a career choice.

F. Similarly, there is a great deal of difference among us in our abilities and interests which are quite important in deciding upon a career.

G. Available funds affect career choices.

H. Through self-study, tests and help from others we can learn a great deal about ourselves which will influence our career choice.

PROCEDURES:

1. Discuss the agricultural industry. Have students think of examples of jobs under each of the following headings: Crop and Livestock Production, Businesses That Provide Materials and Services for Farmers, Agricultural Marketing, Processing and Distributing Businesses, Businesses or Occupations That are not Farm Related.

   Where are the good paying jobs? Where are the good working conditions? Where are the interesting jobs?

2. Show the transparency "Some Characteristics of High School Students Concerning Occupations." Find out if these are true for your class.

3. Have students consider some things they have learned and skills they have acquired which might help one in some of the jobs discussed in Procedure 1. Would a boy who was not farm reared or agriculturally educated have difficulty getting started successfully in some of these jobs?

4. Have students prepare two lists, one of things they like to do and the other of things they dislike doing. Discuss some of these and see if students can see how these should affect career choices.

5. Have students complete the handout, "Studying Yourself." Then, see if students can understand how a better knowledge of their personal characteristics will help in choosing a career.

6. Recommend that students visit with the guidance counselor for a frank appraisal of their abilities and interests as evidenced by tests and other information in the school files. (Many teachers may be able to get even more help from their counselor with this unit if he is not too over-loaded with students.)

7. If the "Vocational Agriculture Interest Inventory" was given to students as eighth graders last year, have them see how much their interests have changed. If it was not given previously, have these students complete the inventory and determine their degree of interest in agricultural pursuits.

8. Have students consider how finances available affect career choices.

9. Show one of the movies on career choice.

SUMMARY:

STUDYING YOURSELF

Answer these questions just as you feel about them. Do not try to answer to please your parents or a teacher.

A. List your first, second and third choice of all subjects you have ever studied in school.
1.______________2._________________3.______________

B. List three subjects you like the least.
1.______________2._________________3.______________

C. List the three subjects where you did your best work.
1.______________2._________________3.______________

D. List the three subjects where you did the poorest work.
1.______________2._________________3.______________

E. What school activities outside of classwork do you especially like?
1.______________2._________________3.______________

F. What work outside of school that you have done interests you?
1.______________2._________________3.______________

G. What do you like to do for amusement?_______________
____

H. What are your hobbies?_____________________________

I. Are there any hobbies, amusements, jobs or studies that you have not had a chance to try that seem of particular interest to you? List them.______________
____

J. Of all the things you do, what do you feel you do best?
________________________Why?_________________________

K. Has anyone ever said that you were good at something, or that you had done a good job at something, or that you have a talent for something? What are these things?____

L. Do you think they were right?_________________________

M. Have aptitude tests, grades or achievement tests indicated that you have an area in which you perform well?____

N. Do you feel that you have any physical limitations that might limit your choice of occupations?_________
____

O. Do you feel that you get along well with other people?
____

SOME CHARACTERISTICS OF HIGH SCHOOL STUDENTS CONCERNING OCCUPATIONS*

1. Needing to decide on occupations.
2. Wanting advice on what to do after school.
3. Wanting to learn trades.
4. Trying to choose the best subjects to prepare for jobs.
5. Needing to know more about occupations.
6. Needing to decide whether or not to go to college.

---

* Six items taken from An Introduction to Agricultural Business and Industry, page 6.

Lesson 2. Considering Modern Agriculture 2 days

OBJECTIVES:

1. To appreciate changes which are occurring in the agricultural segment of the world of work.

2. To increase awareness of the complexity of the agricultural industry.

3. To consider some of the things we should expect from our jobs, things to learn about jobs and something of what jobs will demand of us in the way of advance preparation.

REFERENCES:

An Introduction to Agricultural Business and Industry, pages 11 - 21

		Page
Transparencies:	"Farm Output and Inputs"	14
	"Persons Supplied Per Farm Worker"	15
	"U. S. Farm Production Assets"	16
	"Farm Employment--1940 - 65"	17
	"Major Input Groups as Percentage of Total Inputs"	18
	"Farm Output and U. S. Population"	19
	"World Agricultural Production"	20

MOTIVATION:

What would you think a person should do before deciding upon a career?

OUTLINE:

A. Agriculture is a big business .

B. Some new terms are emerging.
   1. Agindustry
   2. Agri-business
   3. Agricultural Business and Industry
   4. Occupations in Agricultural Production
   5. Occupations in Agri-business
   6. Occupations in the Agricultural Professions

C. Farms are becoming large, efficient business units which are important consumers of goods and services.

D. Many of the businesses serving farmers have become large, specialized concerns needing technically prepared agricultural workers.

E. Anticipated population growth will continue to require an efficiently organized, productive, agricultural industry for a long time to come.

F. Agricultural careers, like others, should be evaluated in terms of their ability to supply satisfaction to the worker. These include:
  1. Creativity
  2. Companionship
  3. Belonging
  4. Service
  5. Security
  6. Success and advancement
  7. Working conditions

G. Lists of questions have been prepared which are useful in evaluating an occupation.

H. We can learn about occupations from the guidance counselors, agriculture teachers, workers, employers, parents and many others.

I. To enter the job market without a high school education would be very fool-hardy.

PROCEDURES:

1. Discuss the evidence that agriculture is big business. Have individual students prepare charts showing trends in farm investment, value of agricultural production and other factors of interest to them.

2. Prepare concise definitions for each of the agricultural terms using the chalkboard and student's suggestions. See that the class understands distinguishing features of each.

3. Show the following transparencies:
   "Farm Output and Inputs"
   "Persons Supplied Per Farm Worker"
   "U. S. Farm Production Assets"
   "Farm Employment - 1940-65"
   (Actual figures accompanying these charts are in Agriculture Handbook 325 USDA). Do these give evidence that farmers are becoming more efficient?

4. See how much students know about business serving farmers locally. Show "Major Input Groups as Percentage of Total Inputs." Is there a large industry serving farmers?

5. Show "Farm Output and U. S. Population" and "World Agricultural Production." What will happen in the U.S. if population grows faster than farm output? What is expected to be the trend in the U. S. population for the next 25 years? What is the significance of this to a person pondering his career choice?

6. Discuss the items dealing with job satisfaction. Have each student consider a job in agriculture and see how it "measures up" with respect to these items. Have a few report on these and permit the class to react.

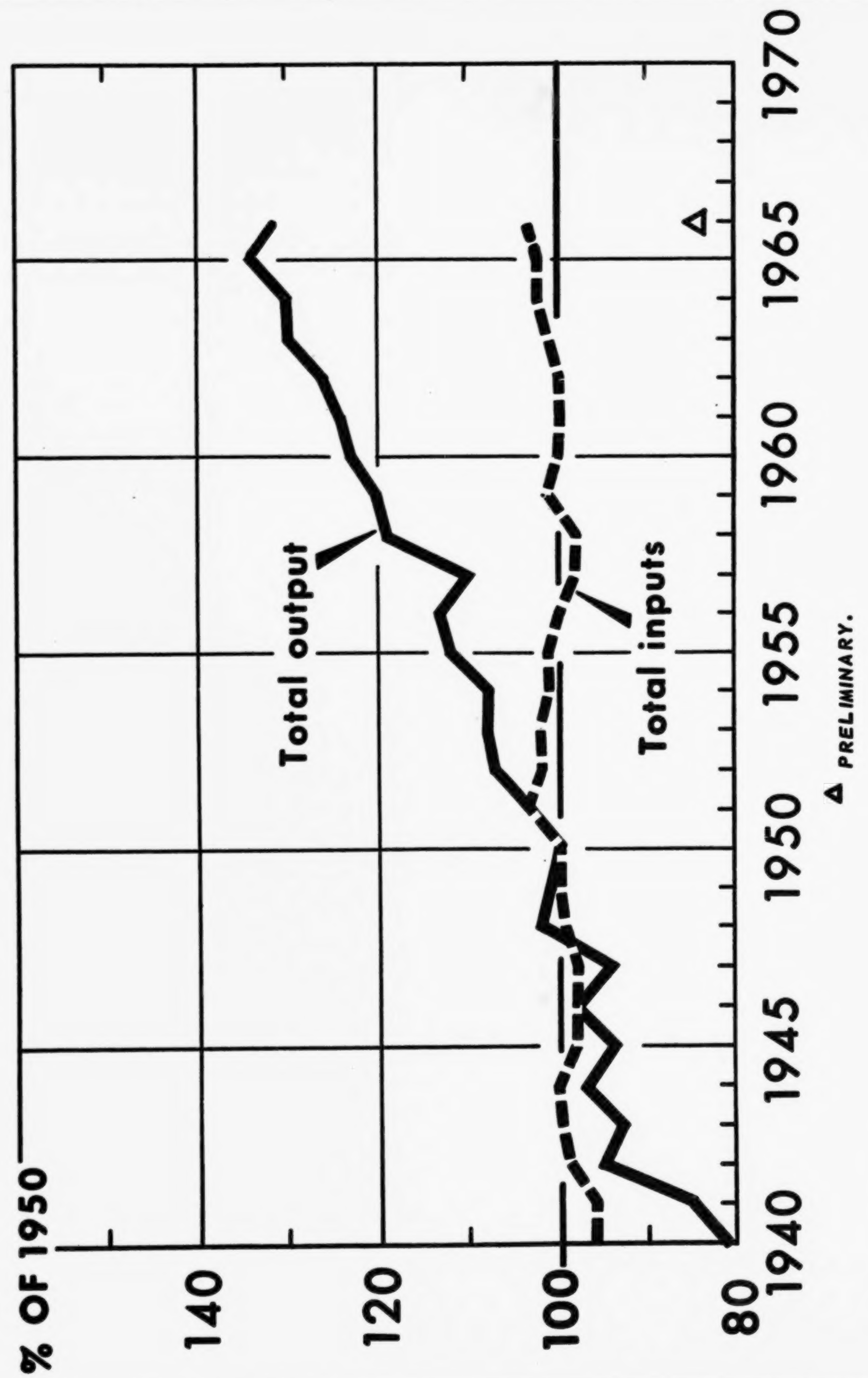
7. Have students consider the list of questions on pages 18 - 19 of the text. Are these the right questions to ask about an occupation? Who can think of an important matter not included?

8. How can we learn more about occupations in which we are interested?

9. How much will it help to finish high school?

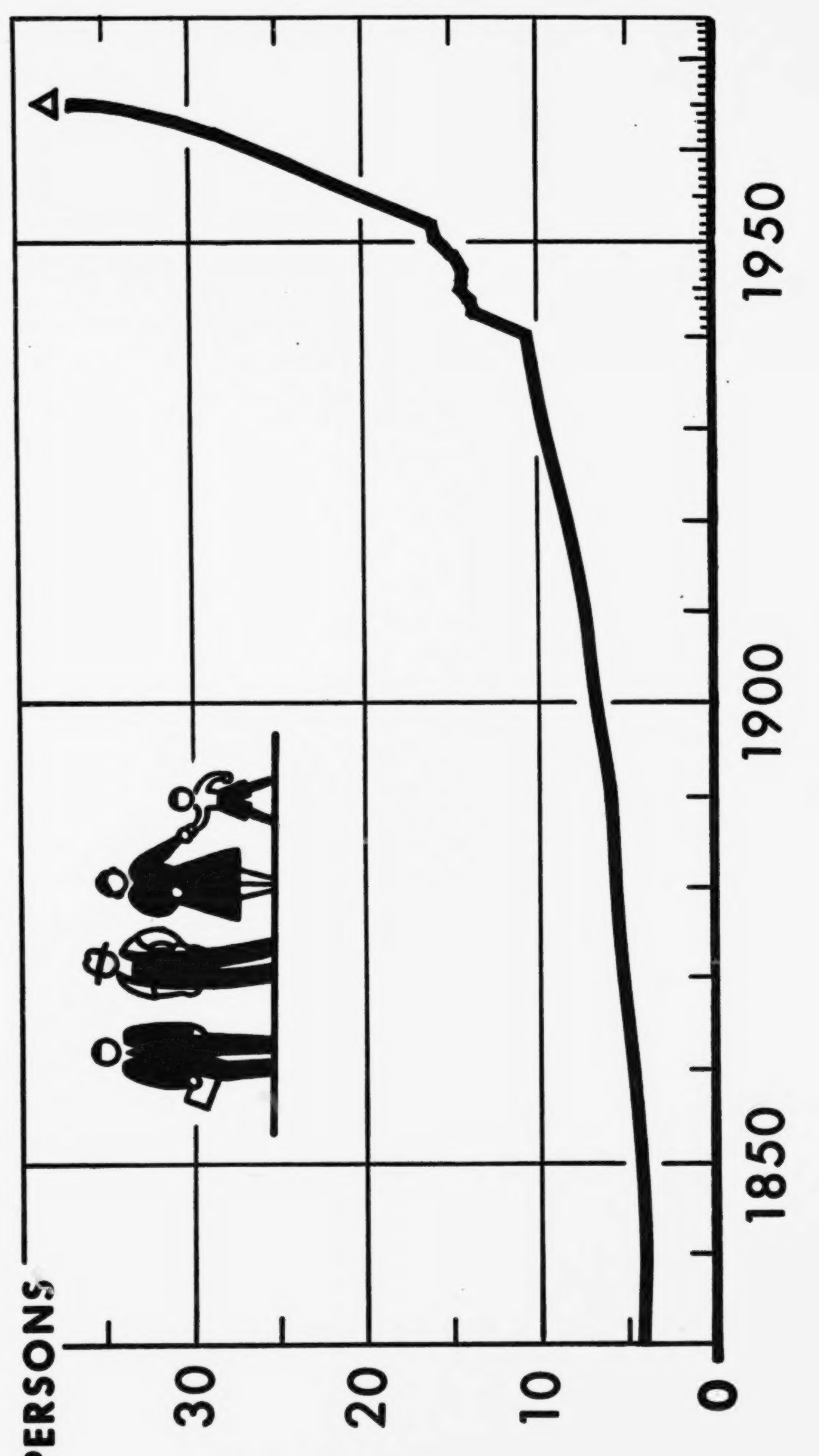
SUMMARY:

FARM OUTPUT AND INPUTS



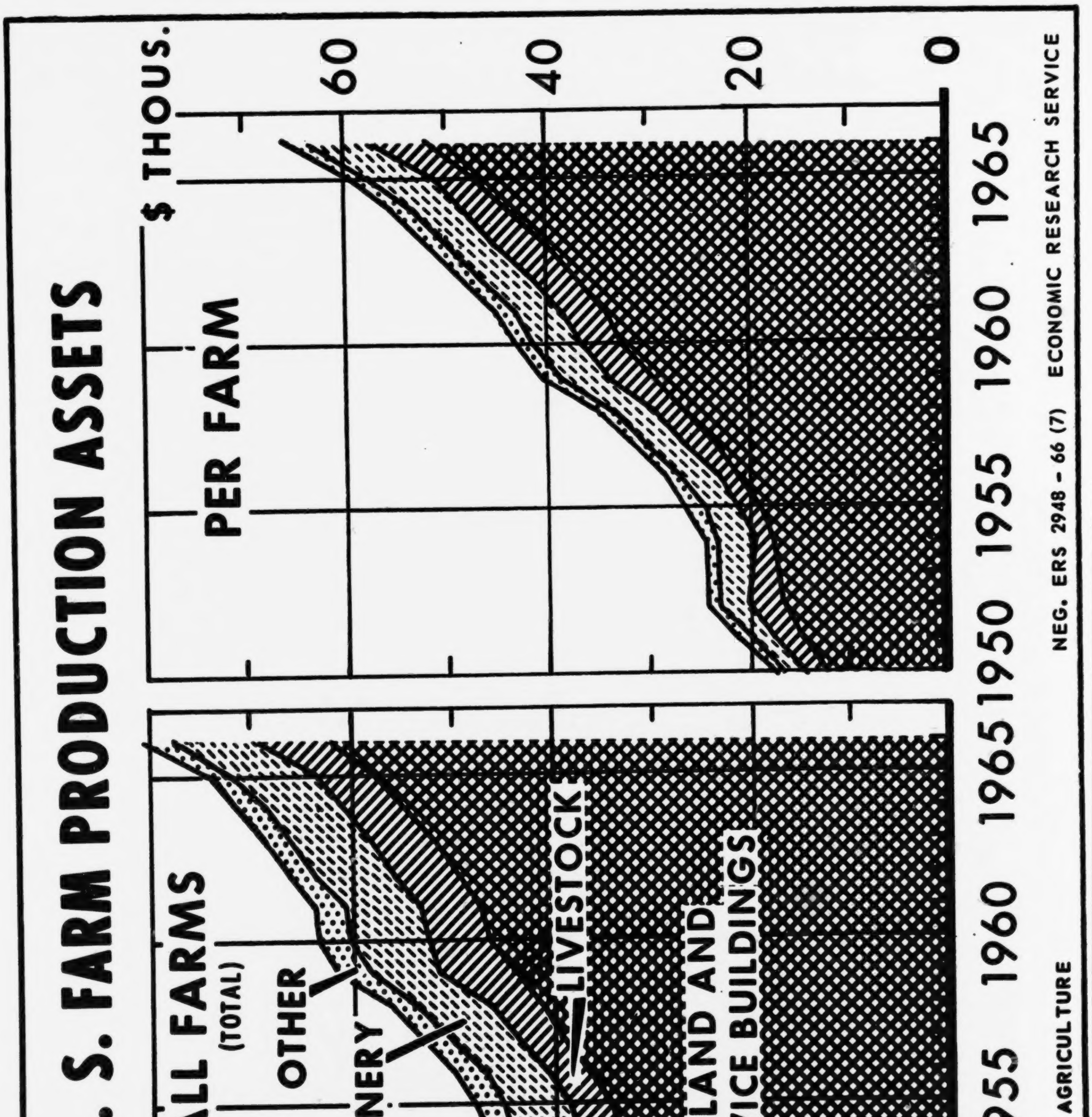
U. S. DEPARTMENT OF AGRICULTURE NEG. ERS 819-66(8) ECONOMIC RESEARCH SERVICE

PERSONS SUPPLIED PER FARM WORKER



Δ PRELIMINARY.

U. S. DEPARTMENT OF AGRICULTURE NEG. ERS 1678X - 66 (7) ECONOMIC RESEARCH SERVICE

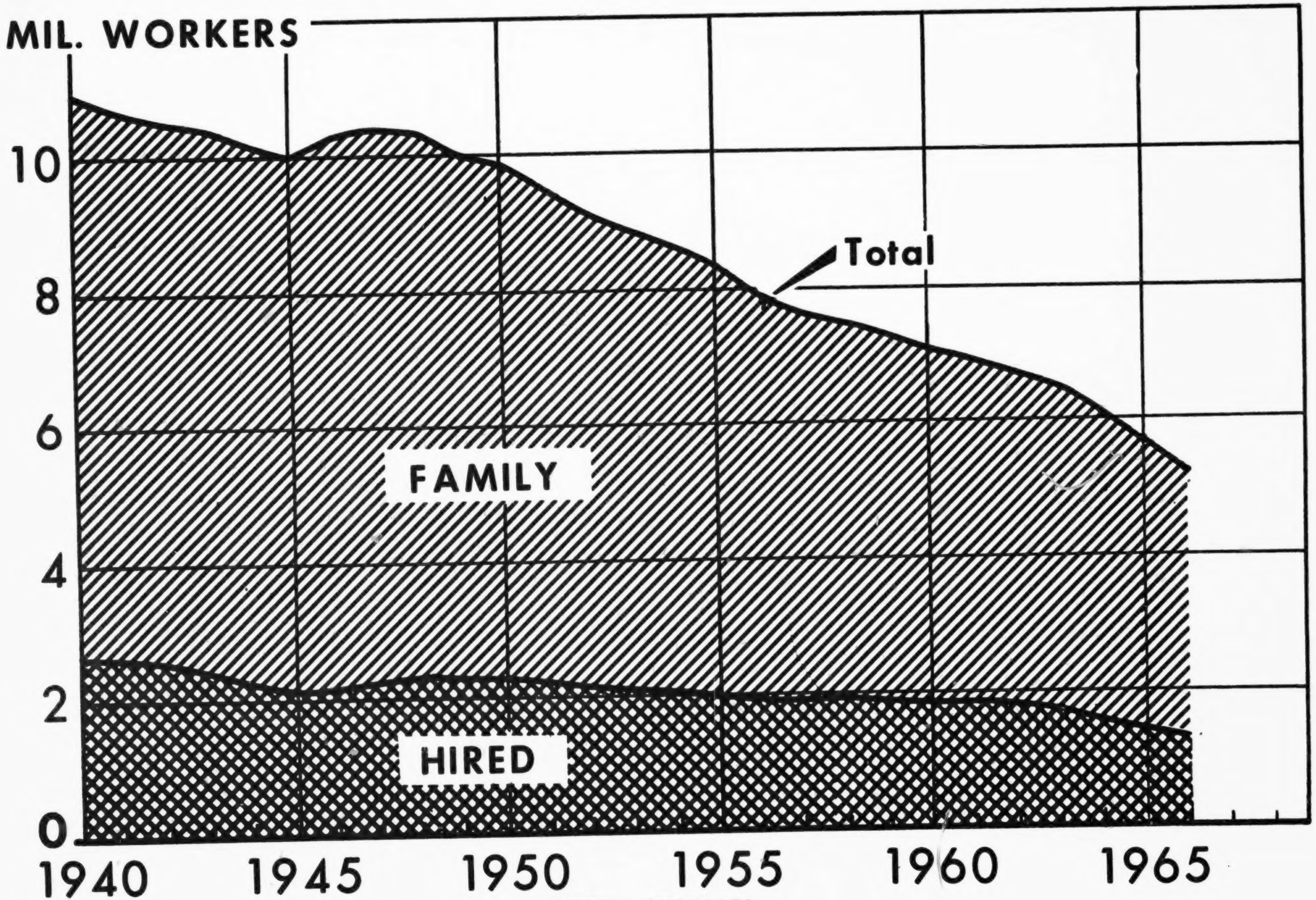


U. S. FARM PRODUCTION ASSETS

U. S. DEPARTMENT OF AGRICULTURE

NEG. ERS 2948 - 66 (7) ECONOMIC RESEARCH SERVICE

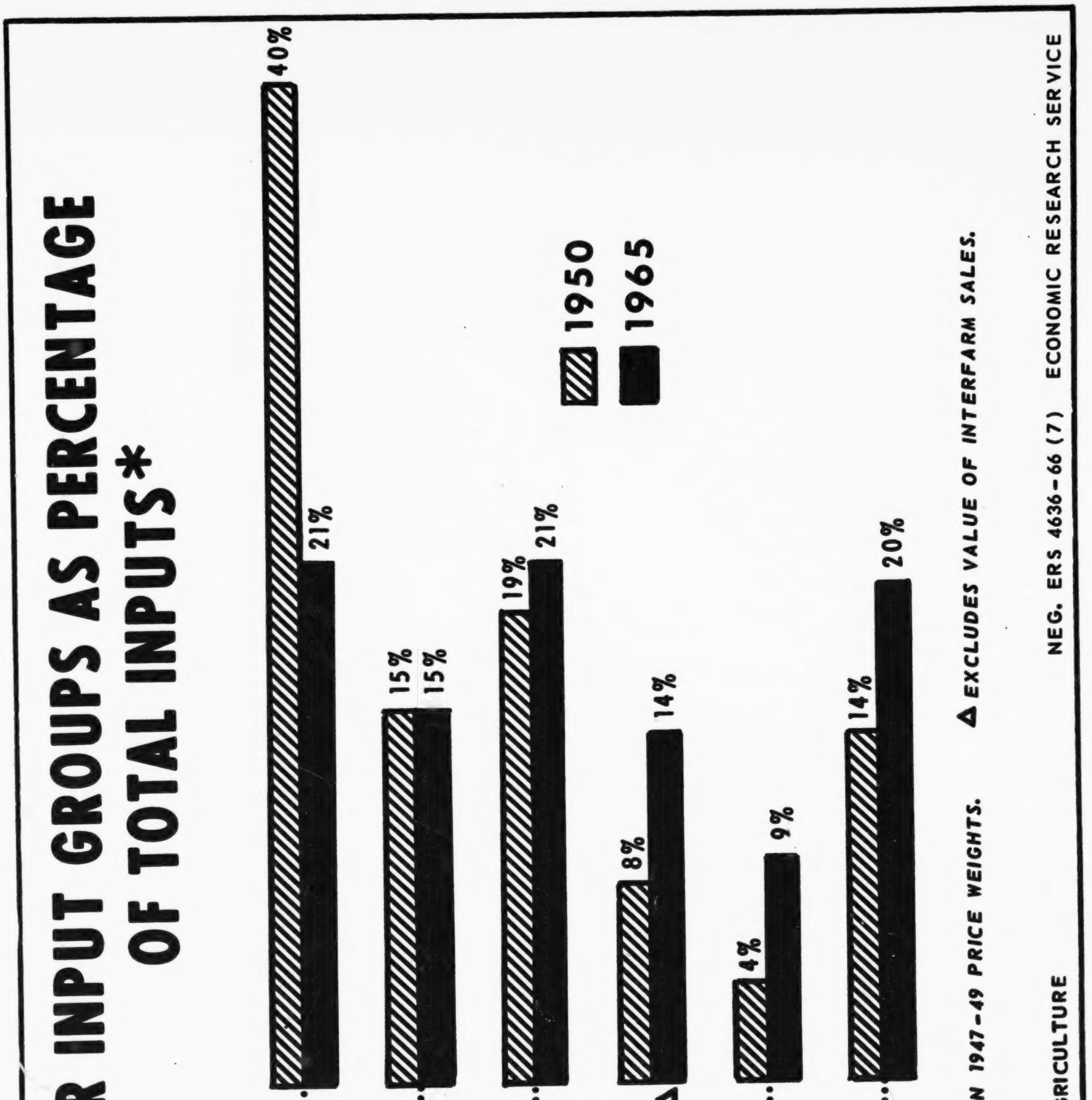
FARM EMPLOYMENT, 1940-65



ANNUAL AVERAGES.

U. S. DEPARTMENT OF AGRICULTURE

NEG. SRS 144-67 (2) STATISTICAL REPORTING SERVICE



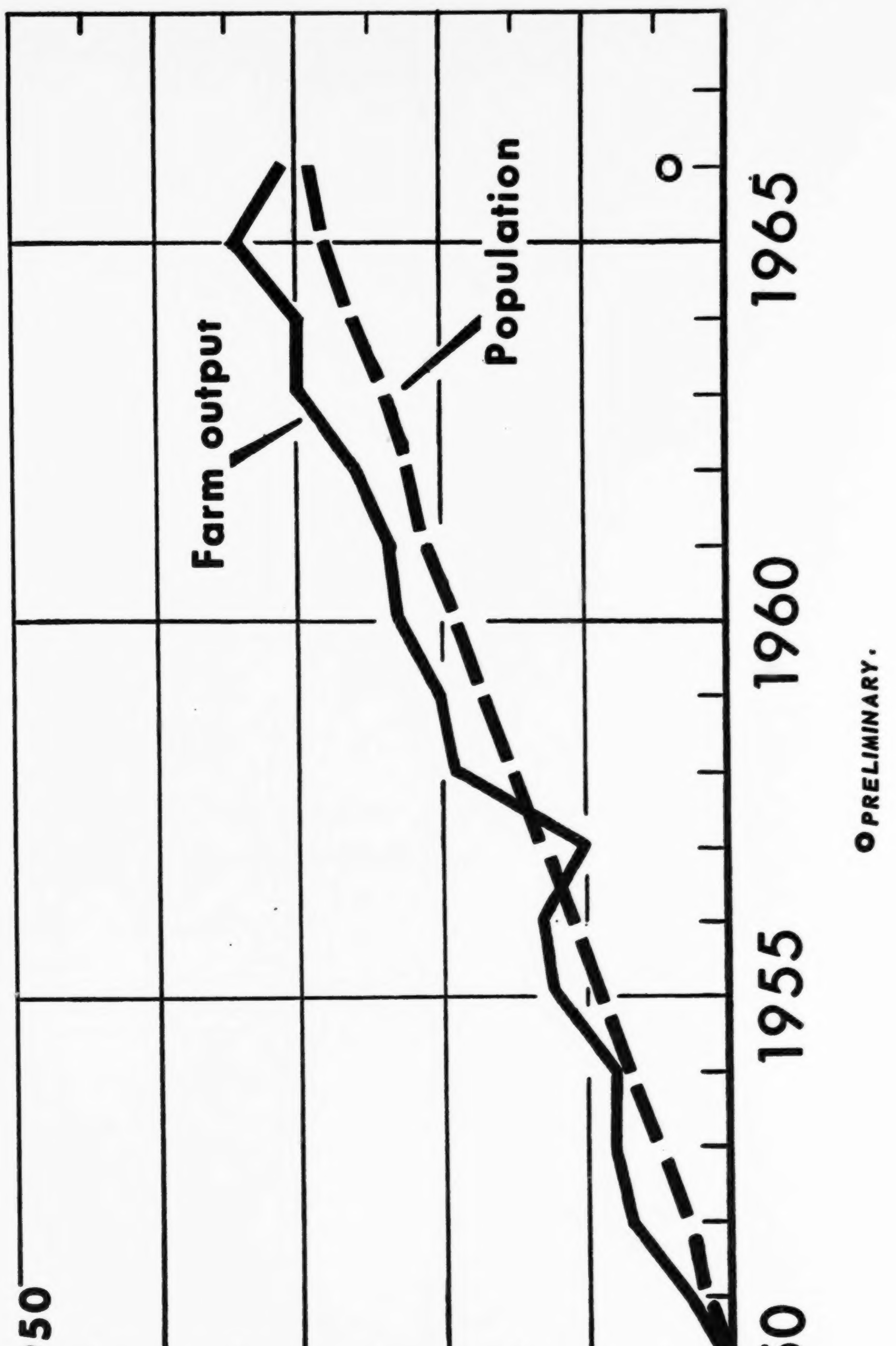
MAJOR INPUT GROUPS AS PERCENTAGE OF TOTAL INPUTS*

* BASED ON 1947-49 PRICE WEIGHTS.

Δ EXCLUDES VALUE OF INTERFARM SALES.

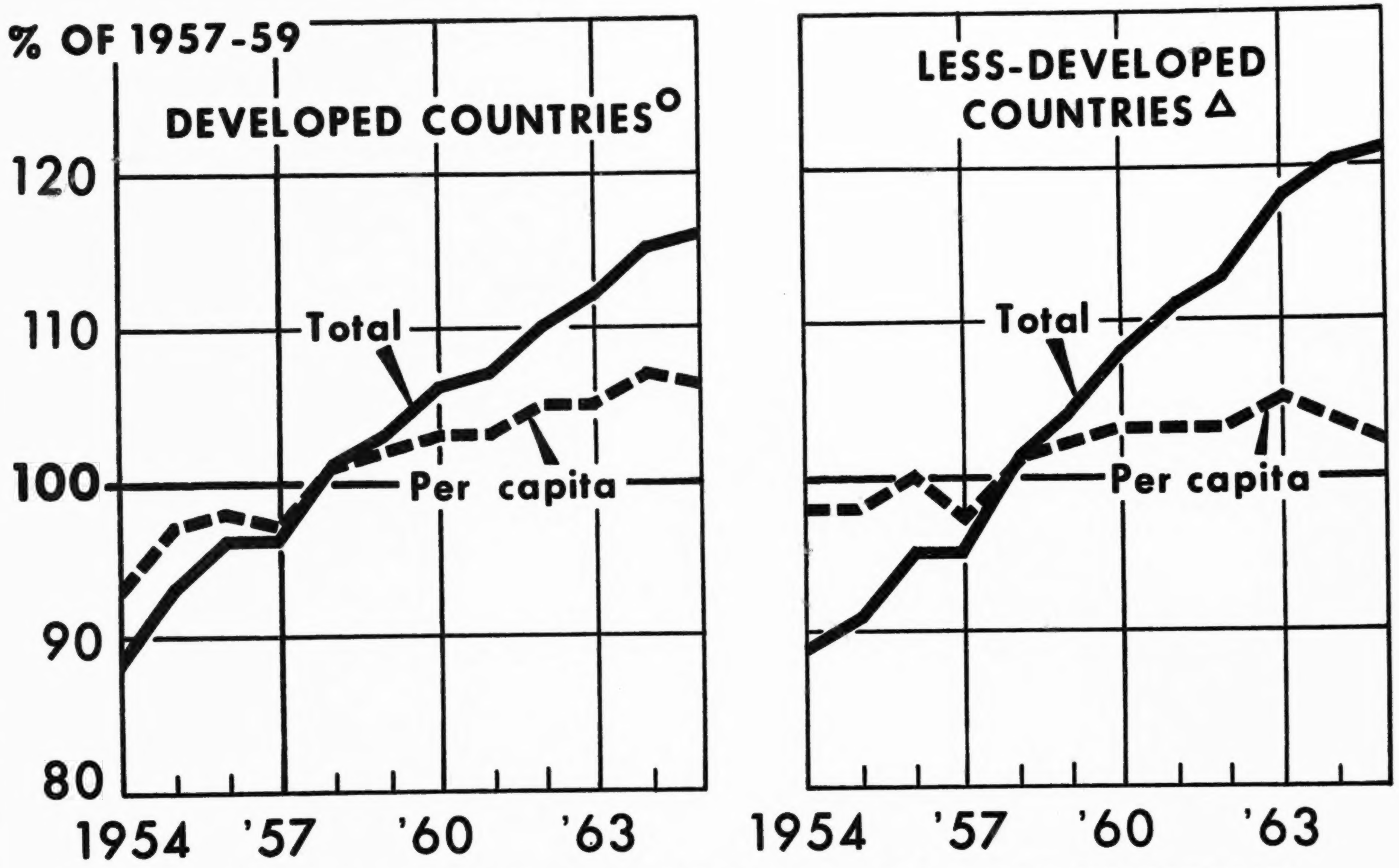
U. S. DEPARTMENT OF AGRICULTURE NEG. ERS 4636-66 (7) ECONOMIC RESEARCH SERVICE

FARM OUTPUT AND U. S. POPULATION



U. S. DEPARTMENT OF AGRICULTURE NEG. ERS 1373 X -66 (9) ECONOMIC RESEARCH SERVICE

WORLD AGRICULTURAL PRODUCTION



○ NORTH AMERICA, EUROPE, USSR, JAPAN, REPUBLIC OF SOUTH AFRICA, AUSTRALIA, AND NEW ZEALAND.
△ LATIN AMERICA, ASIA (EXCEPT JAPAN AND COMMUNIST ASIA), AFRICA (EXCEPT REPUBLIC OF SOUTH AFRICA).

U. S. DEPARTMENT OF AGRICULTURE NEG. ERS 4750-66 (9) ECONOMIC RESEARCH SERVICE

Lesson 3. Some Career Opportunities in Agriculture 3 days

OBJECTIVES:

1. To increase awareness of the diversity of agricultural careers.

2. To encourage students to make a tentative career choice.

REFERENCES:

An Introduction to Agricultural Business and Industry, pages 22 - 30.

	Page
Handout: "Occupational Interview"	24

Supplementary Materials: Careers in Agri-business and Industry
Handbook of Agricultural Occupations
Career briefs and occupational information from any source

MOTIVATION:

Goals are essential to successful endeavor - in school or in life. Experience has shown us again and again that students, who set challenging, realistic, goals for themselves become better students and citizens as a result. For you to choose a career that will require challenging, yet enjoyable preparation is an excellent step toward a rewarding high school experience. Don't be too afraid of making a wrong choice. If it becomes clear that another choice would be wiser, then by all means change your mind and improve your decision. Adults change their career choices several times during a lifetime, frequently without the forethought you will be giving to your decision.

Our assignment is clear. We want each of you to choose that career which most nearly suits you and which will result in the greatest possible satisfaction.

OUTLINE:

A. Employment on Farms
    1. Types of self-employment as owner or tenant
    2. As a paid employee
    3. Farm service occupations

B. Employment in Off-farm Agricultural Businesses
    1. Farm machinery sales and services
    2. Farm supplies and equipment
    3. Livestock industry
    4. Crops, forestry and soil conservation
    5. Ornamental horticulture, wildlife and recreation

C. Professional Occupations in Agriculture

PROCEDURES:

1. Discuss the occupations listed in the text under each category. Have students identify persons they know with as many of these occupations as possible.

2. Consider some of the important ways these occupations differ. Have students think of these differences in relation to their personal characteristics and goals.

3. Discuss level of occupation. See how students relate educational level required and the total satisfactions one receives from an occupation. What happens when a person strives too long for a level that is beyond his reach?

4. Point out the fact that farm students have not attended college to the degree that non farm students have on the average. Also point out the fact that jobs for agricultural college graduates go begging every year. Some get filled by graduates from other colleges because agricultural graduates aren't available. Do you know a graduate of the College of Agriculture? Does he like his work?

5. Have available career briefs for as many occupations as possible. The Handbook of Agricultural Occupations lists many. Students may write for others. Permit students to browse through these materials, visit with one another and the teacher, talk with parents, counselor, other teachers, workers, employers and anyone else who can give them factual information. Use "Occupational Interviews" where appropriate.

6. Have students choose a tentative career. Have them find out everything they can about its requirements, working conditions and satisfactions. Check these against all they've been able to find out about themselves (Lesson 1).

7. Remind students to re-evaluate their choice at least once a year to make sure they still think it is a good one.

SUMMARY:

24
(H)

OCCUPATIONAL INTERVIEW

Name of Job____

What does the worker do?______________________________

What are the working conditions?_______________________

What education is required?__________________________

Is any special training necessary?_________If so what?___

Is physical strength necessary?_____Is it necessary to be handy with tools?_________With numbers?_____________

Communicative skills?________________________________

What are the advantages of this job?____________________

What are the disadvantages?____________________________

What is the present need for workers in this field?_______

__________________________In the future?______________

What dress is required?________________________________

Where are jobs available?______________________________

Any other special requirements?________________________

What are the starting wages?___________What can be expected in the future?________________________________

How do you get started in this job?______________________

Lesson 4. Preparing for a Career 2 days

OBJECTIVES:

1. To see the need for planning ahead.
2. To understand how school experiences can help prepare one for careers.
3. To set down specific plans for achieving occupational goals.

REFERENCE:

An Introduction to Agricultural Business and Industry, pages 30 - 41.

MOTIVATION:

We can drift along and take life as it comes, or we can plan ahead and try to achieve things we believe worthwhile. Most of us find the latter course to be more stimulating and satisfying.

Planning involves use of the intellect. Intellectual activity is generally rewarded more highly than other kinds in our economic system. Planning may be the most important factor in determining whether or not you achieve your goals in life.

In this lesson we want you to plan the things you will need to do in getting ready for your first job and making advancements in your chosen occupation.

OUTLINE:

A. There is a common core of success factors associated with most careers.

B. Specific occupations have additional skill and knowledge requirements.

C. Vocational agriculture can help prepare for a career.
    1. Supervised Occupational Experiences
        a. Production and improvement projects
        b. Group projects or school farm
        c. Off-farm job experience
    2. Study of:
        a. Crops and livestock
        b. Farm management and marketing
        c. Agricultural mechanics

   3. FFA Activities
   4. Contests

D. Other school courses help too.

E. Additional education is often needed beyond high school.
   1. College of agriculture
   2. Adult education classes
   3. Area vocational school courses
   4. Trade school courses

F. A carefully developed plan should include:
   1. High school courses to be taken
   2. Farm experiences including specific skills to be acquired
   3. Other job experiences including specific skills to be acquired
   4. School activities and contests
   5. Colleges or other schools to be attended
   6. Financing needed and how it will be obtained

PROCEDURES:

1. See how many success factors students can list that apply to most jobs. Briefly consider how they can be acquired.

2. Have students think of several agricultural occupations that require specialized skills and knowledge. Consider how these can be acquired.

3. List the items in outline (C) showing how vocational agriculture can help. See how much students know about this. (They should have read the assignment perviously.)

4. Discuss ways other school courses help with specific and common success factors. List some specific courses and examples of how they help.

5. Have students think of agricultural jobs that require additional education. What additional educational requirements do class members have for their occupational choice?

6. List the items that should be included in a plan. Include others as desired by the class.

7. Have each student write out his plan for preparing for his career. Let a few of them report and discuss their plans.

SUMMARY:

LEADERSHIP I

LESSONS:	Days	Page
1. Understanding Essential Qualities of Good Leadership	1	5
2. To Become Familiar with the History and Development of the FFA	1	13
3. How the FFA Organization Operates	3	17
4. Opportunities for Recognition in the FFA	2	23
5. Local Chapter Activities	1	27
6. How Our Chapter Conducts its Business	3	31
7. Using Parliamentary Procedure in Meetings	4	35
Total	15	

OBJECTIVES:

1. To become familiar with the importance of leadership to our society.
2. To learn what good leadership is and how to get started developing it.
3. To understand the FFA as a vehicle for leadership development.
4. To become interested in participating in the FFA.

MOTIVATION:

Developing those personality traits and skills associated with good leadership will contribute more to the success of most students of vocational agriculture than would the acquisition of the finest technical education imaginable. Fortunately, teachers of vocational agriculture have recognized this importance of leadership skills for many years and the FFA organization has grown into an outstanding means for leadership development. Most students should be eager to study this unit.

GETTING READY FOR THIS UNIT:

A. References and Materials
   1. Books
      Offical Manual, Future Farmers of America (page numbers listed are for the 1966 edition)
      A Guide to Parliamentary Practice
   2. Other References
      State Farmer Application Blanks
      Foundation Award Blanks
      State Contest Bulletin

B. Advance Arrangements
   1. Arrange for the class to visit a chapter meeting before Lesson 6.
   2. The sequence of lessons is not important. The entire unit need not necessarily be finished at one time.

EVALUATION:

Interest in participating in the FFA and other leadership developing activities is the best evidence that this unit has been taught successfully. Brief quizzes may be given periodically, anda comprehensive examination at the end of the unit will stimulate serious study and permit students and the teacher to see how effectively objective material has been mastered.

Leadership I

Lesson 1. Understanding Essential Qualities of Good Leadership — 1 day

OBJECTIVES:

1. To realize the importance of good leadership.
2. To recognize its essential qualities.
3. To consider leadership goals and begin making plans to achieve them.

REFERENCES:

		Page
Handouts:	"Leadership"	8
	"What Makes a Good Leader?"	10
	"Personality Self-Rating Scale	11
Transparencies:	Values of Leadership Ability	12

MOTIVATION:

Are leaders born, or are they made?

OUTLINE:

A. Characteristics of Leaders

B. Values of Good Leadership

C. How to Increase Leadership Ability
   1. The First Step
   2. Opportunities to Develop Abilities at School
   3. Setting Leadership Goals
   4. Budgeting Time for Leadership Development

PROCEDURES:

1. Distribute the handout "Leadership" for before class study.

2. Have students name some people they feel are good leaders in the community. Now, have students bring out some of the things they feel make a good leader. Let someone start a list on the chalkboard.

3. Show the transparency, "Values of Leadership Ability."

4. Ask such questions as:
    a. Are these really values of leadership ability?
    b. Are these values important?
    c. To whom are they important?
    d. Why are they important?
    e. How much effort are they worth?
    f. These are values to individuals. Are there values to society too?

5. Discuss ways to increase leadership ability. Let students consider this in their own way, and then see if agreement can be reached on the idea that the first step is for a person to make up his mind he wants to become a leader.
    a. Many people are popular. Are they all good leaders?
    b. Can a popular person become a good leader unless he makes up his mind to?
    c. Decide if a person can be made a good leader.

6. Discuss opportunities for developing leadership ability at school.
    a. FFA
    b. Class and student council organizations
    c. Sports
    d. Speech and other courses
    e. Other school organizations

7. What are your leadership goals?
    a. Will you try to be:
        (1) A chapter officer?
        (2) A committee chairman?
        (3) The best worker on your committee?
        (4) A state officer?
        (5) Other?
    b. What's holding you back?
    c. What must you overcome?
    d. Did you find weaknesses on the "Personality Self-rating Scale"?
    e. How can you improve these traits?

8. Are good leaders involved in several organizations?
    a. How are we to see that we aren't committed to too many responsibilities?
    b. Why will a busy man get the job done while a man who isn't busy may not complete a leadership responsibility? Why do some say, "If you want something done, you should ask a busy person to do it"?

9. Have students turn in one page briefly listing responses to the following:
   a. Why we need leaders.
   b. Why we need followers.
   c. My leadership goals.
   d. Things I must do to achieve these goals.

SUMMARY:

LEADERSHIP*

WHAT IS LEADERSHIP?

Leadership is that combination of qualities which inspires confidence, draws others toward the leader and causes them to follow.

A leader, first of all, is a director of power with all the earmarks of a guide, a coordinator, a chief and a commander. He is a person who can accomplish things which others don't have the heart to attempt.

Walter Lippman said, "The final test of a leader is that he leaves behind him in other men the conviction and will to carry on."

WHY BE A LEADER?

Leadership is needed in all fields, whether it is on the club, community, county, state or national level. Leaders are not born but must be developed among the people that make up a society.

Leadership is a challenge to learn, to train and to develop the natural talents you may have into a force for good. Others will benefit as well as yourself. In most youth project work, the major emphasis is on achieving for yourself. In leadership training, you place emphasis on your value to others. The benefits to yourself are incidental; yet, by assisting others, you gain much.

A person trained for leadership has many of the characteristics that most young people want. He has the respect of others, possesses poise, confidence, the ability to think clearly, and the skill to carry out responsibility.

With responsibility comes maturity. Your development as a leader will help you become a mature person, ready to take your place in society and to serve as a useful, productive, better-adjusted citizen.

WHO CAN BE A LEADER?

Leadership does not depend on the amount of ability you have, but on how you use what you have. You can be a leader if you have the desire, the will power and the urge to develop the qualities and abilities that make a leader. Teachers do not develop musicians and scientists. They inspire people to develop themselves by following good instruction.

Everyone has the ability to be a leader in some way. You need only find the place where you fit as a leader.

* Taken from "Leadership of Youth Groups. A Guide for Officers and Leaders," Farmland Industries, Inc., Kansas City, Missouri

Leaders may be good or bad, depending on the kind of group they are leading and the kind of person they may be. Many people confuse leadership with bossing. This is a mistake.

The boss drives men -- the leader guides them.
The boss depends on authority -- the leader on good will.
The boss creates fear -- the leader develops confidence.
The boss assigns tasks -- the leader sets the pace.
The boss says, "I" -- the leader, "We."
The boss says, "Go" -- the leader says, "Let's go."

HOW DO WE LEAD OTHERS?

The best way to learn leadership is to lead. That does not mean that you must dominate a situation. First of all, you must be fired with a sincere desire -- a desire to serve, a desire to achieve goals, a desire to leave things better than they were when you found them.

There are four definite steps you must take to become a good leader:

1. Study the qualities of recognized good leaders.
2. Study yourself, picking out your own weak and strong points.
3. Develop yourself as a good follower. You will learn that he who cannot obey cannot command.
4. Follow a definite plan of training and improvement in leadership.

Remember that leadership is a role or function, not a mere group of personality traits. "Blessed is the leader who develops leaders while leading." How much easier it is to do a job than to teach another to do it. We frequently find ourselves doing a job for people rather than helping them to help themselves do that job.

The following personality self-rating scale is based on the qualities found in most good leaders. It is intended to help you find your own strong and weak points. Be honest with yourself as you take this, or it will have little value to you.

WHAT MAKES A GOOD LEADER?

Be well prepared -- Know leadership takes work as well as practice.

Be group minded -- Regard yourself as a part of the group. Say "we" instead of "I"; don't try to "run" the crowd. Instead, be guided by the crowd's wishes.

Like people -- Be understanding and friendly.

Be poised -- Don't let irritations bother you.

Have humility -- Be confident, but not cocky. Don't be afraid to reveal you don't know everything.

Be creative -- Enjoy trying new ideas.

Be a hard worker -- Don't ask anyone to do something that you would not be willing to do yourself.

Be responsible -- Live up to your word and duties.

Be cooperative -- Know how to work with others and enjoy working with them.

Be a fun-lover -- Enjoy life -- the simple things as well as the big.

Have vision -- Help the persons in your group to learn and grow through the activities.

Be clear -- Be able to express yourself effectively.

Be proud -- Proud of what you do. Take pride in being a leader, but earn it.

Be neat -- Always be neat in dress and personal appearance.

Be courteous -- The words "please" and "thank you" pay dividends. Use them often.

Think ahead -- Know members' opinions and be ready to meet changing situations.

Set goals -- Make them high, but be sure to reach them.

Take advice -- But do your own thinking.

Get the facts -- Analyze them before you draw conclusions.

Do your best -- At all times. Plan to make the most effective use of your time.

PERSONALITY SELF-RATING SCALE

Circle appropriate number following each trait. Four is outstanding, three is above average, two is average, one is poor. Total your score below.

1. Do I maintain a well groomed appearance? 1 2 3 4
2. Do I have a pleasing voice? 1 2 3 4
3. Is my posture alert and poised? 1 2 3 4
4. Is my disposition cheerful? 1 2 3 4
5. Do I make friends easily? 1 2 3 4
6. Do I exert a positive leadership? 1 2 3 4
7. Am I generally thoughtful of the feelings of others? 1 2 3 4
8. Is my enthusiasm sincere and contagious? 1 2 3 4
9. Do I persevere until I achieve success? 1 2 3 4
10. Am I sincere in my interest in other people? 1 2 3 4
11. Am I ambitious to get ahead? 1 2 3 4
12. Do I get along well with others? 1 2 3 4
13. Do I react constructively to criticism? 1 2 3 4
14. Do I remember names and faces? 1 2 3 4
15. Am I punctual on all occasions? 1 2 3 4
16. Do I have and evidence a spirit of cooperation? 1 2 3 4
17. Am I free from prejudice? 1 2 3 4
18. Do I know how people react in most situations? 1 2 3 4
19. Am I generally a good listener? 1 2 3 4
20. Do I refuse to allow what other people say to hurt me? 1 2 3 4
21. Can I criticize without giving offense? 1 2 3 4
22. Do I usually like people for what they are, or do I wait to see if they like me? 1 2 3 4
23. Do I enjoy being part of a group? 1 2 3 4
24. Am I reliable? 1 2 3 4
25. Can I adapt myself to all situations? 1 2 3 4
26. Am I easily discouraged? 1 2 3 4
27. Do I apply myself to the problems of each day? 1 2 3 4
28. Can I make a decision quickly and accurately? 1 2 3 4
29. Am I loyal to my superiors and associates? 1 2 3 4
30. Do I try to get the other fellow's point of view? 1 2 3 4
31. Am I neat and clean in my work as well as my personal appearance? 1 2 3 4
32. Do I know where I make my mistakes and do I admit them? 1 2 3 4
33. Am I looking for opportunities to serve others better? 1 2 3 4
34. Am I following a systematic plan for improvement and advancement? 1 2 3 4
35. Can I accept honors and advancements and yet keep my feet on the ground? 1 2 3 4
36. Am I playing the game of life honestly and fairly with myself, my fellow members and others with whom I work? 1 2 3 4

TOTAL SCORE . . .

And now, to evaluate your scores -- if your score totaled over 100, your personality rating is definitely superior. And, if you've been honest with yourself, you are among the people who are most likely to succeed. 90 - 100 is above average. 75 - 90 is average. Below 75 shows plenty of room for improvement. How did you rate?

VALUES OF LEADERSHIP ABILITY

1. Education
2. Respect
3. Advancement in an occupation
4. Financial betterment
5. Pride
6. Security

Lesson 2. Basic Background of the FFA 1 day

OBJECTIVE:

To become familiar with the history and development of the FFA.

REFERENCES:

Official Manual, pages 6 and 7 (1966 edition)

	Page
Handout: Quiz - Basic Background of the FFA	15

MOTIVATION:

I wonder how old the FFA is ? Where do you suppose it began?

OUTLINE:

A. Reasons for starting

B. First organizational meeting
   1. Where - Kansas City, Missouri
   2. When - 1928
   3. Number of delegates - 33 from 18 states
   4. First leaders - Leslie Applegate, Dr. C. H. Lane, Mr. Henry Groseclose

C. Official creed adopted - 1930

D. Establishment of National FFA camp - 1939

E. FFA Foundation established - 1944

F. National Band organized - 1947

G. Future Farmer Supply Service - 1947

H. Official FFA Calendar - 1947

I. National Officers Good Will Tour - 1948

J. The Federal Charter - PL740 - 1951

K. Official Code of Ethics adopted - 1952

L. National Future Farmer Magazine established - 1952

M. Cooperation with other nations

N. FFA Headquarters building - 1959

O. Membership - 454,000 in 10,000 chapters

P. Missouri chartered - 28th in 1929

PROCEDURES:

1. Assign pages 6 and 7 of the Manual for careful reading.
2. Have an FFA spell down. Discuss the more interesting aspects of the history.
3. Give the quiz.

SUMMARY:

QUIZ

BASIC BACKGROUND OF THE FFA

1. When was the first National FFA convention held?

2. Where was the first National Convention held?

3. Who was the first National president?

4. During which convention was the creed adopted?

5. When was Vocational Agriculture started?

6. What state organization was the National Association formed after?

7. Of what value to the FFA is public law 740?

8. Missouri was the ____________ state to be chartered in the FFA?

9. Who was the first national advisor?

10. Who is considered the founder of the FFA?

Lesson 3. How the FFA Organization Operates 3 days

OBJECTIVE:

To acquaint the students with the organization of the FFA.

REFERENCES:

Official Manual, pages 8 - 15; 22 (Greenhand Degree requirements)

		Page
Handout:	Quiz - Organization of the FFA,	19
Transparencies:	"Aim and Purposes",	20
	"Code of Ethics"	21
	"Proper Use of Jacket"	22

MOTIVATION:

You will likely want to become an FFA member. First though, you surely want to know more about the organization. Have you ever seen a girl FFA member?

OUTLINE:

A. Colors
   1. Why are they corn gold and National blue?
   2. When were they adopted?

B. Aims and purposes
   1. How many?
   2. What are they?
   3. Do you agree with the aims and purposes?
   4. Can you think of any aims or purposes they may have left out that should be added?

C. What are the types of membership?
   1. Who can be elected to the different types?
   2. What is the purpose of each type of membership?

D. What are the degrees of active membership?
   1. Age
   2. Farming program
   3. Other requirements

E. Emblem
  1. Parts
  2. Purpose or meaning of each part
  3. What protects it from being used by some other organization?

F. Code of Ethics
  1. What is it?
  2. Why do you think it was developed?
  3. Are there any points that you feel are unfair?
  4. Are there any items that could be added to them?

G. Wearing the FFA jacket
  1. How?
  2. When?
  3. Where?
  4. Who?
  5. What to do when it wears out?

H. Services connected with the FFA
  1. Future Farmer supply service
  2. National Future Farmer magazine
  3. National FFA calendar program
    a. What the services are
    b. Dues include the magazine
    c. How ordering supplies will be handled

PROCEDURES:

1. Assign pages for outside reading.

2. Discuss the items in the outline. Use transparencies "Aims and Purposes", "The Emblem," "Code of Ethics," and "Proper Use of Jacket."

3. Be sure students understand how to become a member.

4. Duplicate and hand out "Creed" and "Proper Use of the Official FFA Jacket" if members do not each receive a personal copy of the Manual from your Chapter.

5. Give the Quiz.

SUMMARY:

QUIZ

ORGANIZATION OF THE FFA

1. The FFA colors are ______________ and ______________.

2. The foundation award that is given on the local level to a freshman boy is called the ________________ award.

3. The words Vocational Agriculture are found on the emblem. True or False (circle the correct one)

4. Give the four degrees of active membership in the FFA.

   a.____________________ b.____________________

   c.____________________ d.____________________

5. How many years must you be in the FFA to be an Honorary member? ______________

6. How many aims does the FFA have?

7. What are the pins that can be worn on the FFA jacket?

8. What is the American eagle emblematic of on the FFA emblem?

9. What is the official magazine of the FFA called? ________

   ____

10. How much must you earn or have invested in an agriculture occupation to be eligible for the State Farmer Award?

    ____

THE AIM AND PURPOSES

The primary aim of the Future Farmers of America is the development of agricultural leadership, cooperation, and citizenship. The specific purposes for which this organization was formed are as follows:

1. To develop competent, aggressive, rural and agricultural leadership.
2. To create and nurture a love of country life.
3. To strengthen the confidence of farm boys and young men in themselves and their work.
4. To create more interest in the intelligent choice of farming occupations.
5. To encourage members in the development of individual farming programs and establishment in farming.
6. To encourage members to improve the farm home and its surroundings.
7. To participate in worthy undertakings for the improvement of agriculture.
8. To develop character, train for useful citizenship, and foster patriotism.
9. To participate in cooperative effort.
10. To encourage and practice thrift.
11. To encourage improvement in scholarship.
12. To provide and encourage the development of organized rural recreational activities.

CODE OF ETHICS

(Adopted by the Delegates at the
1952 National FFA Convention)

We will conduct ourselves at all times in order to be a credit to our organization, chapter, school and community by:

1. Dressing neatly and appropriately for the occasion.
2. Showing respect for rights of others and being courteous at all times.
3. Being honest and not taking unfair advantage of others.
4. Respecting property of others.
5. Refraining from loud, boisterous talk, swearing and horseplay.
6. Demonstrating sportsmanship in the show ring, judging contests, and meetings. Modest in winning and generous in defeat.
7. Attending meetings promptly and respecting the opinion of others in discussion.
8. Taking pride in our organization in our activities in our farming programs in our exhibits, and in the occupation of farming and ranching.
9. Sharing with others experiences and knowledge gained by attending National and State meetings.

PROPER USE OF JACKET

1. The jacket should only be worn by persons who are members of the organization.
2. It should be kept clean and neat at all times.
3. The jacket should have only a large emblem on the back and a small emblem on the front; the name of the State Association and the name of the local chapter on the back; and the name of the individual and one office or honor on the front.
4. For the most attractive appearance, the jacket should be worn on official occasions with the zipper fastened to the top. The collar should be turned down and the cuffs in place and buttoned.
5. It should be worn by officers and members on all official FFA occasions, as well as other occasions where the chapter is represented. It may be worn to school and other appropriate places.
6. The jacket should only be worn to places that are appropriate for members to visit.
7. It should be worn by contestants in the National Public Speaking Contest, and at other occasions when FFA members are receiving FFA awards.
8. School letters and insignia of other organizations should not be attached to or worn on the jacket.
9. The jacket should not be worn with garments bearing the insignia of other organizations.
10. When the jacket becomes too faded and worn to wear in public, it should be discarded or the emblems and lettering removed.
11. The emblems and lettering should be removed if the jacket is given or sold to a non-member.
12. When the jacket is worn by a member he always conducts himself as a gentleman.
13. No more than three medals should be worn on the jacket; these should represent the highest degree earned, the highest office held and the highest award earned by the member.
14. Members should refrain from smoking while wearing the FFA jacket or officially representing the organization.

Lesson 4. Opportunities for Recognition in the FFA 2 days

OBJECTIVE:

To acquaint students with some of the honors which they might receive in the FFA.

REFERENCES:

Official Manual, pages 18, 53-54, 22-23 (Chapter, State and American Farmer requirements)

	Page
Handouts: "FFA Contests"	25
"Foundation Awards"	26

Other Materials: State Farmer Application Blank
Foundation Award Blank
State Contest Bulletin

MOTIVATION:

Cite the outstanding achievement of a local member or someone from a neighboring chapter who has received a high honor recently.

OUTLINE:

A. Advanced Degrees
   1. Chapter farmer
   2. State farmer
   3. American farmer

B. Officers
   1. Local
   2. Sub-district
   3. State
   4. National

C. Contest Winners
   1. Local
   2. Sub-district
   3. State
   4. National

D. Foundation Awards
   1. Local
   2. Sub-district
   3. State
   4. National

E. Other local or special honors
   1. Fairs and shows
   2. Superior achievement awards

PROCEDURES:

1. List the five groups of honors. See how much the class already knows about them.

2. Briefly discuss requirements for advanced degrees.

3. List chapter offices. Indicate in a general way how sub-district, state and national officers are selected.

4. Prepare a table similar to the "FFA Contests" sheet which will let students know of their opportunities to participate.

5. Hand out the chart, "Foundation Awards." Help students understand how they can participate. Have them understand who makes these available.

6. Discuss any other activities which give boys in your chapter opportunities for recognition.

SUMMARY:

FFA CONTESTS

	Local	Sub District	District	State	National
Team					
Animal Husbandry					
Poultry					
Soils					
Dairy Production					
Farm Mechanics					
Meat Identification and Judging					
Field Crops					
Dairy Products					
Parliamentary Procedure					
Radio Program					
Chapter					
Chapter Activities*					
Secretary's Book					
Treasurer's Book					
Reporter's Scrap Book					
Individual					
Record Books					
Public Speaking *					
Creed Speaking					

* Same as National FFA Foundation Award contest

FOUNDATION AWARDS

	Local	District	State	Regional	National
STAR GREENHAND	Medal	-	-	-	-
STAR FARMER	Medal	*	$200	$500	$1000
PUBLIC SPEAKING	Medal	*	$100	$200	***
SAFETY	Medal	****	**	$200	$250
ELECTRICITY	Medal	*	**	$200	$250
SOIL & WATER MGT.	Medal	*	**	$200	$250
DAIRY	Medal	*	**	$200	$250
LIVESTOCK	Medal	*	**	$200	$250
CROPS	Medal	*	**	$200	$250
POULTRY	Medal	*	**	$200	$250
FORESTRY	Medal	*	**	$200	$250
FARM & HOME IMP.	Medal	*	**	$200	$250
FARM MECHANICS	Medal	*	**	$200	$250

*May vary from year to year, depending on amount of money available. **These awards will be $100 each for a minimum of five of these contests. Each year five of the contest winners will be certified by the State for participation in the regional and national contests. ***First place $250, second $225, third $200, fourth $175, and fifth $150. ****The MFA awards $50 to first place chapter in each district in the chapter safety contest.

Lesson 5. Local Chapter Activities 1 day

OBJECTIVE:

To acquaint students with activities of the local chapter and help them see some of the values of becoming an active chapter member.

REFERENCES:

	Page
Chapter Program of Work for Current Year.	
Transparency: "Major Divisions of the Program of Work"	29

MOTIVATION:

Discuss the activity of your chapter which is most popular with freshmen boys.

OUTLINE:

A.

B.

C.

D.

E.

F.

* List the most popular activities of your chapter which you want to call to the attention of beginning students.

PROCEDURES:

1. See how much boys may already have heard about activities of your chapter.

2. Do not go into a tedious discussion of every item in your program of work. Instead, show slides of a few activities, of the FFA camp, or do other things which will stimulate interest in the chapter.

3. Show "Major Divisions of the Program of Work." Discuss this briefly so students will appreciate the scope of the program of work and that activities are worthwhile as well as fun to do.

4. Point out that other suggestions for planning and carrying out a program of work may be found on pages 42-53 of the Official Manual.

SUMMARY:

MAJOR DIVISIONS OF PROGRAM OF WORK

1. Supervised Agricultural Program
2. Cooperation
3. Community Service
4. Leadership
5. Earnings and Savings
6. Conduct of Meetings
7. Scholarship
8. Recreation
9. Public Relations
10. State and National Activities

Lesson 6. How Our Chapter Conducts its Business 3 days

OBJECTIVES:

1. To find out how things get done in a chapter meeting.
2. To learn something of the ritual and paraphernalia used in meetings.
3. To appreciate the dignified, businesslike manner of a well-conducted meeting.
4. To understand the importance of out-of-meeting activities for getting things done.

REFERENCES:

Official Manual, pages 32-33, 37-39, 56-60

	Page
Transparency: "Eight Essentials of a Good Chapter"	34

MOTIVATION:

Have the class visit a meeting of the local chapter. Be sure to alert the chapter members to be "on their toes" because future leaders of the organization will be getting an all-important first impression!

OUTLINE:

A. Electing class officers
  1. Obtaining the floor
  2. The correct way to nominate
  3. Seconding nominations
  4. Closing nominations
  5. Voting
  6. Vote required for election
  7. Announcing results

B. Setting up the meeting room

C. Opening the meeting

D. Closing the meeting

E. Planning chapter meetings

F. Order of business

G. Duties of officers

H. Functional committees
   1. Well organized
   2. Meet prior to chapter meeting
   3. Have a plan of action
   4. Get approval from chapter members
   5. Get plan cleared by advisor, principal and superintendent
   6. Put plan into action
   7. Report back to chapter members

I. Eight essentials of a good chapter

PROCEDURES:

1. Elect a set of class officers. Repeat procedures 2 through 4 each day.

2. Have class help the Sentinel set up the meeting room by telling him if he gets paraphernalia in wrong places.

3. Using manuals, go through the opening ceremony and the closing ceremony.

4. Have each student make a drawing of the chapter room giving station, symbol and name of local chapter officer.

5. Discuss planning chapter meetings.
   a. Pre-planning by the executive committee
   b. Why plan well in advance?
   c. How could a freshman member get an item of business before the chapter meeting?

6. Discuss the order of business. List on chalkboard. Why is this order preferred? What would be properly discussed under each item?

7. Discuss duties of chapter officers. Have each officer (class) list his duties. What happens when someone fails to do his job?

8. Discuss importance of committee work. How does a good committee perform?

9. Have the President appoint each class member to a small committee. Each committee should be given a topic, prepare a report and report back during the next meeting session.

10. Show "Eight Essentials of a Good Chapter." Which is most important? Are their others? Can we have a good chapter?

SUMMARY:

EIGHT ESSENTIALS OF A GOOD CHAPTER

1. A Knowledge of the FFA on the Part of Every Member
2. Capable Officers and Leaders
3. Responsibilities Shared by All Members in Chapter Activities
4. A Challenging Program of Work
5. Adequate Financing for Chapter Activities
6. Proper Paraphernalia, Equipment and Records
7. Well Planned, Regularly Held Chapter Meetings
8. Support by School Officials and Community Leaders

Lesson 7. Using Parliamentary Procedure in Meetings 4 days

OBJECTIVES:

1. To appreciate the value of parliamentary procedure for getting business transacted in an orderly manner that is fair to everyone.
2. To learn to make motions correctly and to participate in meetings with ease.
3. To understand how motions are classified.
4. To be able to use several of the commonly used motions correctly.

REFERENCES:

Official Manual, page 61

A Guide to Parliamentary Practice, pages 3-6, 10-13, 14-15, 17, 20, and 21

	Page
Handout: "Frequently Used Motions"	38

MOTIVATION:

England's Parliament is among the oldest organizations to conduct its business in a demoncratic fashion. Both houses of the Congress of the United States have conducted their business in a similar manner. From the experiences of these bodies and others a series of rules have been developed. Two considerations are basic: (1) to get business transacted efficiently and (2) to protect the rights of every member. Would these premises seem appropriate for the FFA organization? What happens when a member doesn't know the rules? Have you seen class meetings "railroaded" by a few who seemed to know the rules?

OUTLINE:

A. Handling the main motion
    1. Securing the floor and making the motion
    2. Seconding
    3. Restating
    4. Discussing
    5. Restating
    6. Voting
    7. Announcing results

B. Subsidiary motions frequently used
   1. Amend
   2. Refer
   3. Lay on the table

C. Incidental motions frequently used
   1. Division
   2. Point of order
   3. Appeal

D. Privileged motions frequently used
   1. Question of privilege
   2. Adjourn

E. Using the gavel correctly
   1. Call meeting to order - 2 taps
   2. Members stand - 3 taps
   3. Members be seated - 1 tap
   4. After announcing results of a vote or a decision of the chair - 1 tap
   5. To restore order - a sharp tap or a series of sharp taps

PROCEDURES:

1. Study the procedure for handling a main motion. Discuss the procedure, then have the class practice introducing and disposing of simple main motions.

2. Explain that subsidiary motions are used to modify or help dispose of main motions. Study and discuss the three listed one by one and have the class practice using them. Hand out the summary "Frequently Used Motions."

3. Explain that incidental motions do not relate directly to the main motion; they are "incidental" to it. Privileged motions are incidental motions of high rank. Study, discuss and practice the privileged and incidental motions listed, one at a time.

4. Divide the class into parliamentary procedure teams and let them demonstrate motions they have learned under simulated contest conditions. Some will meet the 15 minute discussion leader requirement for Chapter Farmer degree during these sessions. Others should be given opportunities with other units during their Green Hand year.

5. Give test each day over the material students have studied in "Frequently Used Motions" handout.

SUMMARY:

(H)

FREQUENTLY USED MOTIONS*

(By order of rank)

	Kind	Second Required	Debatable	Amendable	Vote Required
I.	PRIVILEGED				
	Adjourn	Yes	No	No	Majority
	Question of Privilege	No	No	No	None
II.	INCIDENTAL				
	Point of Order	No	No	No	None
	Appeal	Yes	Yes	No	Majority
	Division	No	No	No	None
	Close Nominations	Yes	No	Yes	Two-thirds
III.	SUBSIDIARY				
	Lay on the Table	Yes	No	No	Majority
	Refer	Yes	Yes	Yes	Majority
	Amend	Yes	Yes	Yes	Majority
IV.	MAIN MOTION	Yes	Yes	Yes	Majority

* Simplified table has a few exceptions to be learned later

SUPERVISED OCCUPATIONAL EXPERIENCE I

LESSONS:	Days	Page
1. Understanding Farming Programs	2	5
2. Selecting the Productive Project Program	5	9
3. Making Arrangements for the Farming Program	3	21
4. Planning Good Management Practices to Use	3	25
5. Planning for Improvement Projects and Supplementary Farm Practices	1	29
6. Carrying Out the Farming Program	1	31
7. Keeping Useful Records	10	33
Total	25	

OBJECTIVES:

1. To conduct supervised occupational experience programs which will help motivate greater classroom participation and achievement.
2. To earn money for future needs.
3. To gain first-hand experience in farm management by accepting responsibility for decisions.
4. To appreciate the value of farm accounts and to learn how to keep them correctly.

MOTIVATION:

Few are so privileged as the teacher of vocational agriculture who watches an enthusiastic youngster plan a supervised farming porgram, put it into operation and grow with it year-by-year. Farming porgrams have formed the very core of vocational agriculture in the past; and, although boys not having excellent possibilities for farming as a career at home would do well to consider other alternatives, there are still many important advantages for every student who has an opportunity to try to grow educationally and financially through these activities.

This unit is written under the assumption that most of the students will see the benefits of a true-to-life farming experience at home and will plan and conduct a supervised farming program. Some will use this as a beginning for growing into farming. Others, as have so many in the past, will find the experience to be an excellent medium for learning initiative, thrift, a sense of responsibility and many other qualities important for success in most occupations.

GETTING READY FOR THIS UNIT:

A. References and Materials
Farming Programs for Students of Vocational Agriculture.
Farm Business Planning Guide

B. Advance Arrangements
1. Have a student who has experienced unusual success visit the class and explain how he started and progressed. (See Motivation for Lesson 1)
2. For Lesson 5 have a student from an advanced class explain his unusually successful improvement project or supplementary farm practice.

Lesson 1. Understanding Farming Programs 2 days

OBJECTIVES:

1. To realize the advantages that can result from having a farming program.

2. To understand the features of a good farming program.

3. To become aware of other opportunities to enhance learning through employment at farm or non-farm jobs away from home.

REFERENCE:

Farming Programs for Students of Vocational Agriculture, pages 31 - 42; 45 - 58; 61 - 68

MOTIVATION:

Have a student from your chapter or a neighboring one who has developed an outstanding farming program visit the class to tell how he got started and progressed with his program. Be sure he saves time for questioning. Be sure his attitude will exhibit his enthusiasm for using farming programs to achieve goals. If he's willing, have him leave some of his records for future discussion. If you have a choice, choose the boy with an original opportunity rather typical of the average freshman boy since students in the class will be inclined to think they could never achieve so much anyway.

OUTLINE:

A. Some goals we can accomplish with farming programs
    1. Increased financial independence
    2. Learning by doing
    3. A sense of accomplishment
    4. Increased management skill
    5. Recognition from others for ability to manage own affairs
    6. Personal pride in a job well done.
    7. Justifiable feeling we're growing up
    8. Long range financial goals - grow into farming, attend college or other advanced schools, other personal desires
    9. Knowledge and skill development for future career and personal life
    10. FFA honors

B. Characteristics of a good farming program
   1. Large enough to achieve your realistic financial and learning goals
   2. Fits in with the home farm and/or other facilities available
   3. Includes enterprises having a favorable comparative advantage economically
   4. Leaves room for Dad
   5. Includes appropriate improvement projects
   6. Includes supplementary farm practices as needed to achieve educational goals
   7. Provides systematic growth from year to year
   8. Emphasizes continuation projects

C. Alternatives to farming programs for those with special situations
   1. Working on a farm
   2. Working for an agricultural business

PROCEDURES:

1. See what students already know about farming programs. (Don't clear up all of the misconceptions at once - some will be resolved through later study.)

2. After they've read the assignment, develop a list of reasons for farming programs on the chalkboard. See if they agree with all in item "A" in the Outline. What are some important goals of students in this class? Are there disadvantages of farming programs?

3. Discuss the characteristics of good farming programs. Let students contribute items or list the ones in the Outline and have students evaluate them and add others if they desire.

4. Will everyone here have a farming program? Overcome the poor reasons some may have for not having programs by pointing out alternatives they haven't considered. For those students for whom a farming program is not reasonable, discuss the alternatives. Help the class see how these students can gain some of the advantages of farming programs without participating.

5. Have available a list of the farming activities conducted by several freshmen who later became outstanding FFA members over the past several years. (See annual reports or record books if you have them.) Distribute these or present them before the class for discussion.

6. Suggest students start thinking about how a farming program can help them achieve some of their important goals.

SUMMARY:

Lesson 2. Selecting the Productive Project Program 5 days

OBJECTIVES:

1. To compare farm enterprises in their suitability for student projects.
2. To learn to use outlook information in short-term planning.
3. To understand the kinds of expense items to be expected with various enterprises.
4. To learn to make a financial plan (budget) for an enterprise.
5. To learn the basic steps in decision-making.
6. To plan a program of productive projects to be carried out by the student during the current year.
7. To plan a 5 year program of productive projects.

REFERENCES:

		Page
Farm Business Planning Guide		
Handouts:	"Comparing Livestock Enterprises"	13
	"Comparing Crop Enterprises"	14
	"Budget for a Crop Enterprise"	15
	"Budget Livestock Production"	16
	"Prices for Budgeting 19__" (Receipts)	17
	"Prices for Budgeting 19__ (Expenses)	18
Transparency:	"The Decision-making Cycle"	19

MOTIVATION:

We're going to be farm managers. We'll start in a small way, but we'll be decision-makers just the same as any other manager, and we'll have to be responsible for our decisions.

OUTLINE:

A. Livestock enterprises suitable for a farming program in this locality
    1. Income over costs for the various classes
    2. Capital required

   3. Labor required
   4. Equipment and other facilities required

B. Crop enterprises suitable for a farming program in this locality
   1. Income over costs for the crops
   2. Capital required
   3. Labor required
   4. Equipment and other facilities required

C. The outlook for crop and livestock prices for the ensuing year
   1. Livestock cycles
   2. Consumer demand expectations
   3. Acreage allotment changes
   4. Export policies
   5. Other factors expected to be particularly important in determining prices this year

D. Steps in Preparing a Budget
   1. Select a suitable form (Livestock or Crop Enterprise Book, page 2).
   2. Decide upon prices - consider current prices and outlook.
   3. Use tables in Farm Business Planning Guide to determine typical expense and receipt items to use.
   4. Carefully check computations and whether all pertinent items are included.

E. Steps in the decision-making process
   1. Observe the situation .
   2. Analyze the situation considering goals and alternatives.
   3. Decide .
   4. Put plan into action .
   5. Assume responsibility for the decision (Evaluate).

F. Deciding which enterprises to include
   1. Consider facilities, labor and capital available .
   2. Consider relationship to other enterprises on the farm .
   3. Consider financial goals .
   4. Prepare budgets for several promising enterprises.

PROCEDURES:

1. Prepare a list of livestock projects suited for farming programs in this area. Work from the annual supervised farming program report, Tables 11 to 17 of the Planning Guide and from student suggestions. Bring in county census data or otherwise encourage consideration of enterprises you feel need more emphasis.

2. Distribute the handout, "Comparing Livestock Enterprises." Have students find the data needed in Tables 11 to 17. Facilities and equipment may have to come from textbooks and your help. When completed for enterprises suited to your locality, prepare a transparency and discuss the items. Have students indicate some of their preferences and their reasons.

   Emphasize that figures in the Farm Business Planning Guide are excellent for planning several years ahead. We will be budgeting more accurately using expected prices for next year in a day or so.

3. Prepare a list of crop projects suited for farming programs in this area. (See the suggestions from Procedure 1.)

4. Use the handout, "Comparing Crop Enterprises." (See other suggestions for Procedure 2.)

5. Discuss the outlook for next year and factors which are expected to be important in determining prices needed by this class in budgeting. Decide upon prices yourself, or have your advanced class do this as a farm management exercise. Hand out a set of prices for these students to use in budgeting. The sample list includes most of the commodities used in the budget blocks in the Planning Guide which are expected to vary in price from year to year. For all other prices, it is recommended that students use costs just as they are listed in the budget blocks unless they know their situation will be different.

6. Work out a sample budget for a livestock enterprise with the class. Use your price list and data from the budget block in the Planning Guide.

   You may want to use the Turkey illustration included here, but be sure to check prices of mash, poults and turkeys sold.

   Interest on investment should be figured at the rate student pays if he actually borrows; otherwise charge what seems to be a reasonable rate to expect on funds he has to invest, maybe 5%. Note that the Turkey budget varies from Table 17 only in the way interest is handled. (Subtract $103.04 from $3116.80 to get $3013.76)

   Make sure the class understands how every figure was derived.

7. Have students work in groups to develop budgets for other livestock enterprises.

8. Work out a sample budget for a crop enterprise. Use the wheat budget if you like, but be sure to change the prices of wheat to fit the outlook. Use other than 1/3 - 2/3 share if not typical. Note that Gross Returns (line 4, Table 8) should read $56.25, not $57.25 for 45 bu. @ $1.25.

9. Have students work in groups to prepare budgets for other crops.

10. Discuss the steps in the decision-making process. See if students can relate these steps to their farming programs.

11. Discuss considerations in deciding what enterprises to include in the farming program. See if students agree with those in the outline and if they want to add others.

12. Show "The Decision-Making Cycle." Compare with E. in Outline. Tell the class we are now at step 3 in the decision-making process. Have them (with guidance from their parents and you) decide upon their productive projects for this year. Also have them consider tentative plans for 4 more years. Have them make the plans in their notebook.

13. Remind students they aren't good managers unless they carry out steps 4 and 5 in the decision-making process. The next few lessons will help, but getting it done is up to the young manager.

SUMMARY:

Occupational Experience I

COMPARING LIVESTOCK ENTERPRISES

Kind	Income	Labor Hrs.	Capital	Equipment and facilities
Sow and 8 pigs	$ 91.00	20	$227.	Farrowing house, fenced pasture or confinement lot, feeders, waterers, etc.

(H)

COMPARING CROP ENTERPRISES
(Per Acre)

Kind	Income	Labor Hrs.	Equipment and facilities
CORN - 80 bu.	$61.00	7.6	Equipment for preparing seedbed, planting, fertilizing, controlling weeds, harvesting, storing.

15
(H)

BUDGET FOR A CROP ENTERPRISE

Make this budget soon after the enterprise is chosen, using amounts and prices based on your previous records, farm records, experimental data, and agricultural outlook information. Use this budget as a guide in developing a business agreement which will be fair to both parties, and to give a picture of the amount of cash, supplies, etc., needed for the enterprise. Refer to page 3 for additional instructions.

Acres and Kind of Crop 10 Wheat (no allotment) 1/3 to landlord For the Crop Year 19____

Estimated Returns (Cash and Noncash)				Total Enterprise		Value of Amount Due Each Party by Agreement			
A. Items of Return to be Expected	Number, Amount	Price per Unit		Total Value		Student		Other Party	
1. Crop on hand at close of project		$		$		$		$	
2. Closing inventory, other									
3. Crop sold 45 Bu/acre	450 bu	1	25	562	50			187	50
4. Crop used at home									
5. By-products									
6.									
7. Estimated Total Returns				$562	50	$375	00	$187	50

Estimated Costs (Cash and Noncash)				Total Enterprise		Cost to Be Furnished by Each Party			
B. Items of Cost Expected	Number, Amount	Price per Unit		Total Cost		Student		Other Party	
8. Opening inventory		$		$		$		$	
9. Hired labor									
10. Power and machinery	10 acres	5	37	53	70				
11. Seeds, plants and supplies	10 acres	2	80	28	00				
12. Fertilizer, lime and manure	10 acres	17	50	175	00				
13. Cash rent									
14. Land (No. acres x value per acre x 7%)									
15. Other costs									
16.									
17.									
18. Estimated Total Cost				$256	70	$256	70	$ —	

	Total Enterprise		Student		Other Party	
C. Net Profit or Loss (7-18) Labor Income	$305	80	$118	30	$187	50
D. Hours of Self Labor 3.9 x 10	39 hrs.		39 hrs.		hrs.	
E. Labor Income per Hour of Self Labor (C ÷ D)	$		$ 3	03	$	

BUDGET

Occupational Experience I

Livestock Production

Turkeys
(Name of Enterprise)

Make this budget soon after the enterprise is chosen, using amounts and prices based on previous supervised farming records, farm records, experimental data, and agricultural forecasts. Use this budget as a guide in developing a business agreement which will be fair to both parties, and to help determine the amount of cash, feed, supplies, etc., needed for the enterprise.

Number and Kind of Animals 1000 Turkeys

For the Period Jan. 1 19__ to Dec. 31 19__

	Total Enterprise			Amount Due Each Party by Agreement			
A. EXPECTED RECEIPTS AND CREDITS (cash and noncash)	Amount	Value		Student		Other Party	
1. Closing livestock inventory	head	$		$		$	
2. Closing inventory, other items							
3. Animals sold	880	3520	–				
4. Products sold or used at home							
5. Manure produced and properly handled	tons						
6.							
7.							
8. Total Receipts and Credits	XXXXXX	$3520	–	$		$	
B. EXPECTED EXPENSES AND DEBITS (cash and noncash)	Total Enterprise			Cost to Be Furnished by Each Party			
*9. Beginning livestock inventory	head	$		$		$	
*10. Beginning inventory, other items							
11. Hired labor	hrs.						
12. Building and equipment costs—not inventoried							
13. Feed	XXXXXXXXXXXXXXX			XXXXXXXXXXXXXXX			
a. ~~Grain~~ Mash	63,360 lbs.	2280	96				
b. Supplement Fuel and litter	lbs.	40	00				
c. Poults	1000 ~~lbs.~~ head	620	00				
d.	lbs.						
e.							
**14. Other:	XXXXXX	XXXX	XX	XXXX	XX	XXXX	XX
a. Interest paid (7%)	1472	103	04				
b. Vet. and drugs		20	00				
c. Misc. exp.		52	80				
d. Interest on investment @____%	dols.						
15. Total Expenses and Debits	XXXXXX	$3116	80	$		$	
	Total Enterprise			Student		Other Party	
C. NET PROFIT OR LOSS (Labor Income) (Item 8 minus item 15)	XXXXXX	$ 404	20	$		$	
D. HOURS OF SELF LABOR	100 hrs.	XXXXXXX		hrs.		hrs.	
E. LABOR INCOME PER HOUR OF SELF LABOR (Item C divided by D)	XXXXXX	$ 4	04	$		$	

*Include planned additional inventory purchases
**See pages 7 and 8 for listing of other costs

PRICES FOR BUDGETING 19__

(Receipts)

Item	Unit	$____
Cotton	Lb.	
Corn	Bu.	
Oats	Bu.	
Barley	Bu.	
Wheat	Bu.	
Soybeans	Bu.	
Grain sorghums	Cwt.	
Alfalfa hay	Ton	
Grass hay	Ton	
Mixed hay	Ton	
Corn silage	Ton	
Sorgo silage	Ton	
Improved pasture	Ton	
Other pasture	Ton	
Stalks, etc.	Ton	
Soybean oil meal, 44%	Ton	
Eggs: market	Doz.	
Eggs: hatching		
Broilers	Doz.	
Layers	Doz.	
Cull hens		
Light breeds	Lb.	
Heavy breeds	Lb.	
Broilers	Lb.	
Baby pullet chicks		
Purebred	Each	
Hybred	Each	
Turkey poults		
Heavies	Each	
Lights	Each	
Turkey hens	Lb.	
Turkey toms	Lb.	

Item	Unit	$____
60 lb. feeder pig	Head	
Barrows and gilts	Cwt.	
Sows	Cwt.	
Slaughter cows 900-1100 lbs.		
Commercial	Cwt.	
Cutter	Cwt.	
Canner	Cwt.	
Slaughter steers 900-1000 lbs.		
Choice	Cwt.	
Good	Cwt.	
Slaughter steers		
Standard, all weights	Cwt.	
Slaughter heifers		
Choice	Cwt.	
Good	Cwt.	
Slaughter calves 600-800 lbs.		
Choice	Cwt.	
Good	Cwt.	
Feeder cattle 500-800 lbs.		
Choice	Cwt.	
Good	Cwt.	
Medium plain	Cwt.	
Calves, steers, 300-500 lbs.		
Choice	Cwt.	
Good	Cwt.	
Calves, heifers, 300-500 lbs.		
Choice	Cwt.	
Good	Cwt.	
Ewes, culls	Head	
Lambs: fat spring	Cwt.	
fed	Cwt.	
feeder	Cwt.	
Wool: govt. payment incl.	Lb.	
Milk: fluid	Cwt.	
Mfg.	Cwt.	

PRICES FOR BUDGETING 19__

(Expenses)

Corn Equivalent $______________

Alfalfa Hay ______________

Mixed Hay ______________

Grass Hay ______________

Silage ______________

Pasture (Hay Equivalent) ______________

Dairy Mix ______________

Hog Creep Feed ______________

Hog Supplement - 40% ______________

Beef Supplement ______________

Pullets (Reared) ______________

Laying Mash ______________

Broiler Chicks ______________

Turkey Poults ______________

Turkey Mash ______________

______________ ______________

______________ ______________

______________ ______________

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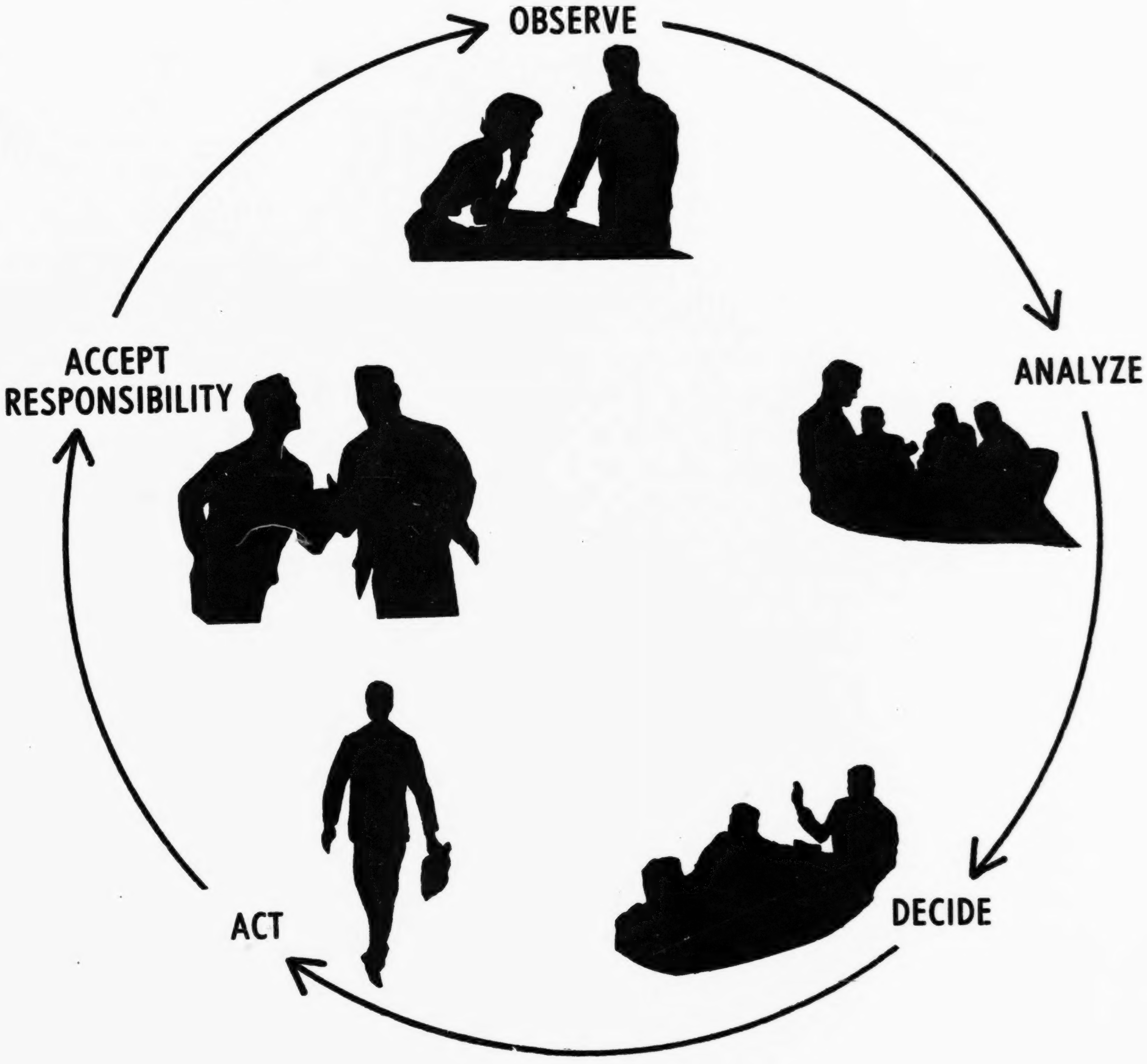

OBSERVE
ANALYZE
DECIDE
ACT
ACCEPT RESPONSIBILITY

THE DECISION-MAKING CYCLE

Lesson 3. Making Arrangements for the Farming Program 3 days

OBJECTIVES:

1. To think carefully about the arrangements that will need to be made and make sure all items are provided for that will be needed in the farming program.
2. To understand the advantages of a good credit rating and how the farming program provides an excellent opportunity to establish a good financial reputation.
3. To prepare written agreements that will make suitable arrangements for farming program needs.

REFERENCES:

Farming Programs for Students of Vocational Agriculture, pages 125 - 157; 161 - 178

Farm Business Planning Guide, Tables 2 - 17

MOTIVATION:

What would you think of borrowing $1,000 and going into the steer feeding business? A boy in this class did last year. Do you want to guess how he came out? (Use your own local example.)

You have about decided on some productive projects for making you some money. Many of you have excellent uses already planned for the money. What's going to happen to this money we hope to have if we fail to make arrangements for things that will be needed. Do you feel sure you can meet all needs of your project?

OUTLINE:

A. Deciding what will be needed
    1. Livestock enterprises
        a. Foundation stock
        b. Feeder stock
        c. Buildings and equipment
        d. Pasture, lots, fences
        e. Water
        f. Grain
        g. Hay and/or silage
        h. Supplement
        i. Labor
        j. Miscellaneous expenses

2. Crop enterprises
    a. Land
    b. Machinery
    c. Fertilizer
    d. Seed
    e. Chemicals
    f. Labor
    g. Miscellaneous expenses

B. Methods of providing needed items
1. Purchase
2. Rent
3. Borrow
4. Trade

C. Renting money
1. Most managers find it profitable to pay interest on money needed in their business. Interest is an expense item just as feed, fuel and fertilizer are.
2. A good credit rating is an important asset for any manager. One may earn a good credit rating by:
    a. Using credit when needed in productive ventures
    b. Being businesslike in making loan requests
        (1) Know your needs
        (2) Know your business - net worth, efficiency, plans for the future
        (3) Know what returns can be expected
        (4) Know when you can make repayment(s)
        (5) Don't be apologetic - you are the customer
    c. Repaying on schedule or being prompt and businesslike in explaining why you can't
    d. Keeping accurate records
3. Credit agencies exist for profit in a competitive market. Get the cheapest credit your risk situation will permit.
    a. Have as much collateral as possible.
    b. Borrow for productive rather than consumer purposes whenever you have the choice. (Cow vs. car)
    c. Have someone with a strong credit rating "go your note."
    d. Act like a businessman.
    e. Shop around.
4. Local credit sources for farming programs
    a. Banks
    b. PCA
    c. Other

D. Deciding how to arrange for other items
   1. Partnership arrangements - divide income based on value of the contribution each party makes. Use budget form for this purpose.
   2. Customary share rent in the community--boy pays for Dad's machinery he uses if this would normally be supplied by tenant.
   3. Other arrangements agreed to by mutual consent.

E. Preparing an agreement which will provide the items needed for successful completion of the project
   1. Kind, size and duration of project
   2. What I will furnish
   3. What the other party will furnish
   4. What part of the returns I will receive
   5. What part of the returns the other party will receive
   6. Other agreements. Source of money I will need.

PROCEDURES:

1. How do we decide what arrangements will need to be made to carry out the project? Discuss items in the budgets. See if they want to add other items to those listed in the outline for livestock and for crops.

2. How can we provide the needed items? What will be hardest to provide?

3. How do you feel about borrowing money? Discuss "renting money" as outlined. Take plenty of time for this subject with this age group. Illustrate with FFA boy examples as often as you can.

4. If you have someone especially interested in FFA project loans (PCA, banker, etc.), ask him to visit your class, or FFA meeting, and help acquaint students with loan procedures.

   Show him the outline ahead of time and let him elaborate on items he deems important as well as adding other tips to young managers.

   Try to get him to save one-half of his time for questions. Encourage students to borrow their money away from home.

5. Remember the ways we can provide needed items? (See procedure 2.) How will you arrange for the items you need?

Will a partnership help? How much rent is right? How can we decide about such arrangements?

6. This class is quite immature for a complex discussion of lease arrangements, figuring how to divide proceeds, etc. It is recommended that for the class as a whole a few rules of thumb be discussed which are typical of how your students share expenses with their fathers. Include such items as land rental for principal crops, pasture rent, what to do about manure value, how to charge for machinery, etc. If you haven't written this down anywhere, you may want the farm management class to study arrangements of this sort in detail and prepare a set of guidelines for underclass students.

   You may have a very few students requiring a great deal of help in working out a fair agreement or partnership at home. At this age, individual instruction is recommended to solve these problems. Teachers with limited experience may even want to solicit assistance from another professional agriculturalist who has worked in the community longer.

7. Have students begin writing their project agreements and getting details arbitrated with their parents. Write agreement outline on the board.

8. Have some of the first students to finish read their agreements and discuss these with the class. These students can then write agreements for additional projects or help others write theirs. Have them keep the agreements in their notebooks.

SUMMARY:

Lesson 4. Planning Good Management Practices to Use 3 days

OBJECTIVES:

1. To realize the importance of good management practices.
2. To learn how to find recommended practices.
3. To select and write down some of the important management practices to be performed with each project.

REFERENCES:

Farming Programs for Students in Vocational Agriculture, pages 71 - 88; 181 - 192 -

Farm Business Planning Guide, Tables 7 - 17 (Goals)

Textbooks, bulletins and MU Guide sheets on the production of enterprises included in student's farming programs.

MOTIVATION:

It has been said that one can learn to farm from a bulletin. While it must be tempered with judgment and experience, this is a statement bearing a great deal of truth. A vast amount of research has been done in the production of crops and livestock over the past 100 years and much of this has been translated into how-to-do-it publications. And, the results of research are accumulating at an ever increasing rate, so it is important to follow recent recommendations.

A farmer, or student, would indeed be foolish to ignore all of this and rely on his judgment entirely in caring for livestock or crops. Judgment (management) still gets into the picture, however, since we have to choose between recommended practices in a state of uncertainty regarding prices, climate, etc. Research cannot eliminate all uncertainty.

We all want to do a good job with our farming program. What goals do you have for your sow and litter? What are some practices you feel sure will help you achieve your goals?

OUTLINE:

A. The importance of high production
    1. Higher return to labor
    2. More is left after "fixed costs" are paid .
    3. High production is usually (but not always) more efficient production.

B. The importance of producing a quality product
   1. Price is usually higher.
   2. Industry often benefits from making quality products available.

C. The importance of controlling pests in livestock and crops
   1. Quality of the product is usually improved.
   2. Yield is usually increased.
   3. The community benefits if farmers cooperate to control pests.

D. The importance of efficient production
   1. High production isn't always the most profitable.
   2. There are often substitutes which will achieve the same results at less cost.
   3. Inefficient farmers, like other independent businessmen, lose money and finally lose their businesses.

E. Pride of a job well done is an important reason for using good management practices.

F. Good, recent, bulletins, books and MU Guide sheets are available that include improved practices which will help us achieve our goals. Dad, neighbors, merchants and others are also useful sources of approved practices.

G. Writing out improved practices in detail will help conscientious students think them through and will encourage getting the practices completed.

PROCEDURES:

1. Give the students 10 minutes to find as many approved practices as they can for the projects in their farming programs. List one example for each enterprise before they start, so they all know what they are doing. Give each student the reference(s) most useful for his particular enterprise.

2. On the chalkboard, list the headings: High Production, Quality Product, Controlling Pests, Efficient Production, Pride. Discuss the practices students have found. Have them see how many fit under each of the headings. What additional headings are needed to categorize all of the practices?

3. Now, discuss the first five items in the Outline. Let students illustrate as many as their experiences permit. You illustrate some too.

4. Have the students list production goals for their enterprises. The Farm Business Planning Guide is a good basis for these. Remind them that profit is the uppermost goal (if educational values are excluded) and have them select a realistic profit goal.

5. Discuss the value of writing out plans for production practices. Keep reminding them of their goals.

6. Help the students see how to use the table of contents of most textbooks to outline the jobs they will need to perform. Then, have them list the approved practices under each stage of the development of their project. See pages 183 - 186 of Farming Programs for Students of Vocational Agriculture for stages if needed. Give them lots of supervision to be sure they know what they are doing. Have students with similar projects work together, brighter ones help slower ones, etc. to get meaningful lists prepared.

7. Have one or two students read their plans. Discuss for detail, completeness, correctness of practices. What about decisions he can't make yet?

8. Remind students that good managers, like women, change their minds when more evidence is in. Planning and re-planning should continue as long as we are able to learn.

9. What are other sources of approved practices? What will you do when a crisis arises that you have not anticipated?

SUMMARY:

Lesson 5. Planning for Improvement Projects and Supplementary Farm Practices

1 day

OBJECTIVES:

1. To see the value of including these projects and practices in a farming program.
2. To develop plans for appropriate improvement projects and supplementary farm practices.

REFERENCES:

Farming Programs for Students in Vocational Agriculture, pages 116 - 122

MOTIVATION:

Discuss a very successful improvement project of a student.

Have a student from an advanced class explain how much he has learned from his improvement and supplementary farm practices.

Discuss the value of these projects for advanced degrees in the FFA.

Would any of you want to live on a run-down, poorly kept farm? Would the farm produce its maximum income under these conditions? Do you need to know about enterprises other than those in your farming program?

OUTLINE:

A. Improvement projects are performed for their educational value and for the benefits received by the farm family.
   1. Livestock improvement
   2. Crop improvement
   3. Soil, woodland, wildlife conservation
   4. Buildings and equipment

B. Supplementary farm practices are skill-development activities.

C. Both types are to supplement the productive projects in a student's farming program, and therefore, should not include improvements or practices that can be learned in the student's productive projects.

PROCEDURES:

1. Discuss the Outline. Be sure students understand the purposes and the differences.
2. Have students plan these projects to supplement their productive projects.
3. Encourage them to learn as many skills (SFP) as they can. Suggest they limit improvement projects to one or two having enough scope to be a noticeable improvement.

SUMMARY:

Lesson 6. Carrying Out the Farming Program 1 day

OBJECTIVES:

1. To get the plan put into action.
2. To understand the importance of this step in accomplishing our goals.
3. To realize that this step really involves the acceptance of responsibility.
4. To discover some tips for getting things done.

REFERENCES:

Farming Programs for Students in Vocational Agriculture, pages 195 - 212.

MOTIVATION:

Do you know "idea" people - people who seem to have another brilliant idea every time you see them? Some idea people never get anything done, and they fail.

Industry can sometimes use an idea man even if he won't follow through because there are lots of other people to get the work done. Is this the way it is on a farm too?

OUTLINE:

A. Importance of achieving our goals

B. Assuming responsibility

C. Using approved practices

D. Keeping up with things to be done

E. Checking on progress

F. Where to get advice, help

G. If things do not turn out well

PROCEDURES:

1. After students have read the assignment, discuss the items that are in the Outline.
2. Have them put their things to do (approved practices) in order on a calendar basis.
3. Encourage them to discuss special problems they anticipate in getting things done.

SUMMARY:

Lesson 7. Keeping Useful Records 10 days

OBJECTICES:

1. To understand how records can be useful.
2. To find out what records to keep.
3. To learn to record items correctly in the record books.

REFERENCE:

Farming Programs for Students in Vocational Agriculture, pages 215 - 218; also 218 - 235.

		Page
Transparencies:	"A Cash Record Summary"	36
	"A Farm Record Summary" (Inventories Included")	37

MOTIVATION:

One farmer bought a new car, remodeled his kitchen and had $500. more in the bank at the end of the year than at the beginning. He thought things were going great until his records proved to him that he had lost money for the year. How could this be? Show transparency "A Cash Record Summary." Could inaccurate records be the problem? Could the records have been accurate, and something else account for the loss? Show "A Farm Record Summary." Give students as much time as they need to understand this. This situation is quite typical of many farmers who we say "live off their inventory." How long can this continue?

OUTLINE:

A. Reasons for keeping records
  1. To see how much profit
  2. To see where we were efficient and where we were inefficient
  3. To compare our results with others
  4. To help plan for next year
  5. To learn how to keep records
  6. To show we're growing up, maturing, acquiring business ability
  7. For income tax and social security purposes

B. What records to keep
  1. Required for determining profit
    a. Expenses
    b. Receipts
    c. Inventories
  2. Other useful production records
    a. Management practices completed
    b. Shows
    c. Breeding
    d. Losses
    e. Diary
  3. Some other interesting and useful records
    a. Improvement projects completed
    b. Supplementary farm practices completed
    c. Farm mechanics projects completed
    d. Inventory and record of buildings, equipment and real estate
    e. Inventory and record of livestock and crops
    f. Net worth statement
    g. Major new investments and payments on debts
    h. Record of money borrowed and owed
    i. Income and expenses other than supervised farming
    j. FFA leadership and cooperative activities

C. Learning to keep neat, accurate records.

PROCEDURES:

1. Discuss reasons for keeping records. List items (A in Outline) on chalkboard. Are these good reasons? Which is most important? Can you think of others?

2. List records required for determing profit (B.1 in Outline). Review "A Farm Record Summary" transparency to see if these three will be sufficient to determine profit.

3. Distribute Crop Enterprise and Livestock Enterprise record books as needed by students. Discuss the recording of expenses, receipts and inventories. Have students record any of these they have been accumulating since their projects started.

4. Discuss other production records and have students record any of these they have accumulated. Have them record good management practices developed in Lesson 4 after you have checked them.

5. Distribute the Permanent Record and Planning Book and browse through it with students helping them see how it can be used to record valuable information. Discuss the value of the other interesting and useful records.

6. Throughout the remainder of the year spend about a day a month working with the record books. Spend the first part of each period on one of the following assignments:
   a. Recording five year plans for productive enterprises, improvement projects, supplementary farm practices, and farm mechanics (pages 1 - 4 of Permanent Record and Planning Book)
   b. Recording budgets for crop and livestock projects.
   c. Recording business agreements
   d. Completing Inventory and Record (Pages 5 and 6 Permanent Record and Planning Book.)
   e. Completing Net Worth Statement
   f. Completing Major Net Investments and Payments on Debts, Record of Money Borrowed and Owed, Income and Expenses Other Than Supervised Farming (pages 8 and 9.)
   g. Recording FFA Leadership and Cooperative Activities. Also remind students to keep expenses and receipts up-to-date at these sessions. Check their books soon after each session.

SUMMARY:

A CASH RECORD SUMMARY

Cash on hand - end of year	$1000	
Cash receipts	$17500	
Total Credits		$18500
Cash on hand - beginning year	$500	
Farm Expenses	$10000	
Total Debits		$10500
Credits over debits		$8000

He spent $8000 for personal use and left an additional $500 in the bank at the end of the year. Is this good business?

A FARM RECORD SUMMARY

Total Closing Inventory	$61000	
Cash Receipts	$17500	
Total Credits		$78500
Total Opening Inventoy	$69500	
Cash Expenses	$10000	
		$79500
Profit or loss		-$1000

He lost $1000. Where did he get the $8000 for personal living and extra $500 to put in the bank? Would it be extremely unusual for a farmer to have an $8500 decrease in inventory?

ANIMAL SCIENCE

SUBUNITS:	Days	Page
1. Introductory Lesson	2	3
2. Livestock Selection	11	15
3. Animal Breeding	9	125
4. Animal Nutrition	8	163
5. Producing Swine For Profit	15	215
Total	45	

OBJECTIVES:

1. To appreciate the importance of livestock in our economy.
2. To become familiar with breeds and classes of livestock commonly found in Missouri and to have a general understanding of desirable type for each.
3. To understand some elementary principles of animal breeding and animal nutrition.
4. To understand how principles of livestock production are applied in the production cycle of a swine project.
5. To discover something of the nature and extnet of career opportunities in the livestock industry.

Introductory Lesson: Livestock in the Economy 2 days

OBJECTIVES:

1. To become familiar with the importance of the livestock industry.

2. To appreciate the extent of job opportunities associated with the industry.

3. To understand some of the reasons livestock are so important in our economy.

4. To consider the future of the industry as it relates to population trends.

REFERENCES:

1. Textbooks
   Animal Science: Preface and Chapter I
   Data for Missouri Counties
   Census of Agriculture (Missouri)
2. Movies (Select 1 of these)
   Source: Communications Department
   119 Whitten Hall
   Columbia, Missouri

		Minutes
"Agriculture's Showcase Abroad"	Color	13½
"Livestock and Mankind"		11
"Meat, Milk and Money with Livestock on Concrete"	Color	15
"Miracle of Feeding America"	Color	27
"Miracles from Agriculture"	Color	14
"Salt of the Earth"		20

3. Transparencies

	Page
"Pig Crops and Hog Slaughter"	6
"Sheep Numbers and Lamb and Mutton Production"	7
"Cattle Numbers, Beef Production and Population"	8
"Meat Consumption per Person"	9
"Milk Production, Cow Numbers and Milk per Cow"	10
"Income and Commercial Consumption of Milk Solids"	11
"Poultry and Egg Production and Population"	12
"Gross Farm Income from Poultry and Eggs"	13
"Per Capita Consumption of Poultry and Eggs"	14

MOTIVATION:

Who enjoys working with livestock? Who enjoys eating livestock products? What are some ways you think the livestock industry is important in our country?

In this lesson we are going to consider some of these questions so we will be knowledgeable agriculturalists on this subject. Many students of vocational agriculture pursue careers in the livestock industry. Some of you will surely do the same.

OUTLINE.

A. Trends in numbers of livestock and in consumption of livestock products in the U. S.
    1. Hogs
    2. Sheep
    3. Beef
    4. Dairy
    5. Poultry and eggs

B. Uses of Livestock on Farms
    1. To convert low value feeds into higher value animal products
        a. Grains
        b. Hay
        c. Pasture
        d. Mill and packing house products
        e. Damaged grains, foods, garbage
    2. To control erosion by holding soil in place with roughage crops grown for livestock feed
    3. To help maintain soil fertility by returning some nutrients to the soil in manure
    4. To diversify the enterprise
        a. Distributes risk
        b. Improves labor distribution

C. Other Uses and Values of Animals
    1. Animal products are rich in essential food nutrients needed for a healthy population.
    2. Wool, leather, hair and furs are important raw materials for clothing and other useful products.
    3. Horses and mules, buffalo, reindeer, elephants, camels, dogs have been used as sources of power.
    4. Recreation is provided by horses and dogs, hunting and fishing, bird watching, trips to the zoo, etc.

D. Food vs. Population
    1. World population growing
    2. Heavily populated nations tend to be vegetarians.

PROCEDURES:

1. Show one of the movies to help acquaint students with the industry. Discuss the movie with students to see what they think of the livestock industry.

2. Show the transparencies following this section and discuss each of them briefly remembering that your purpose is to give a general impression of the importance of each segment of the industry.

3. Consider with the class some of the reasons why farmers keep livestock.

4. What kind of farm makes a good livestock farm? Let students ponder and discuss this question. They will answer the question in greater detail later.

5. What kind of farmer makes a good livestock man? Have students react to this question. See if they list most of those on page 30 in Animal Science.

6. How would you like to be a vegetarian? Why are there vegetarians in so many parts of the world? Will it happen here?

7. From Data for Missouri Counties, Census of Agriculture (Missouri) and similar sources have students determine relative importance of livestock classes in their county(s).

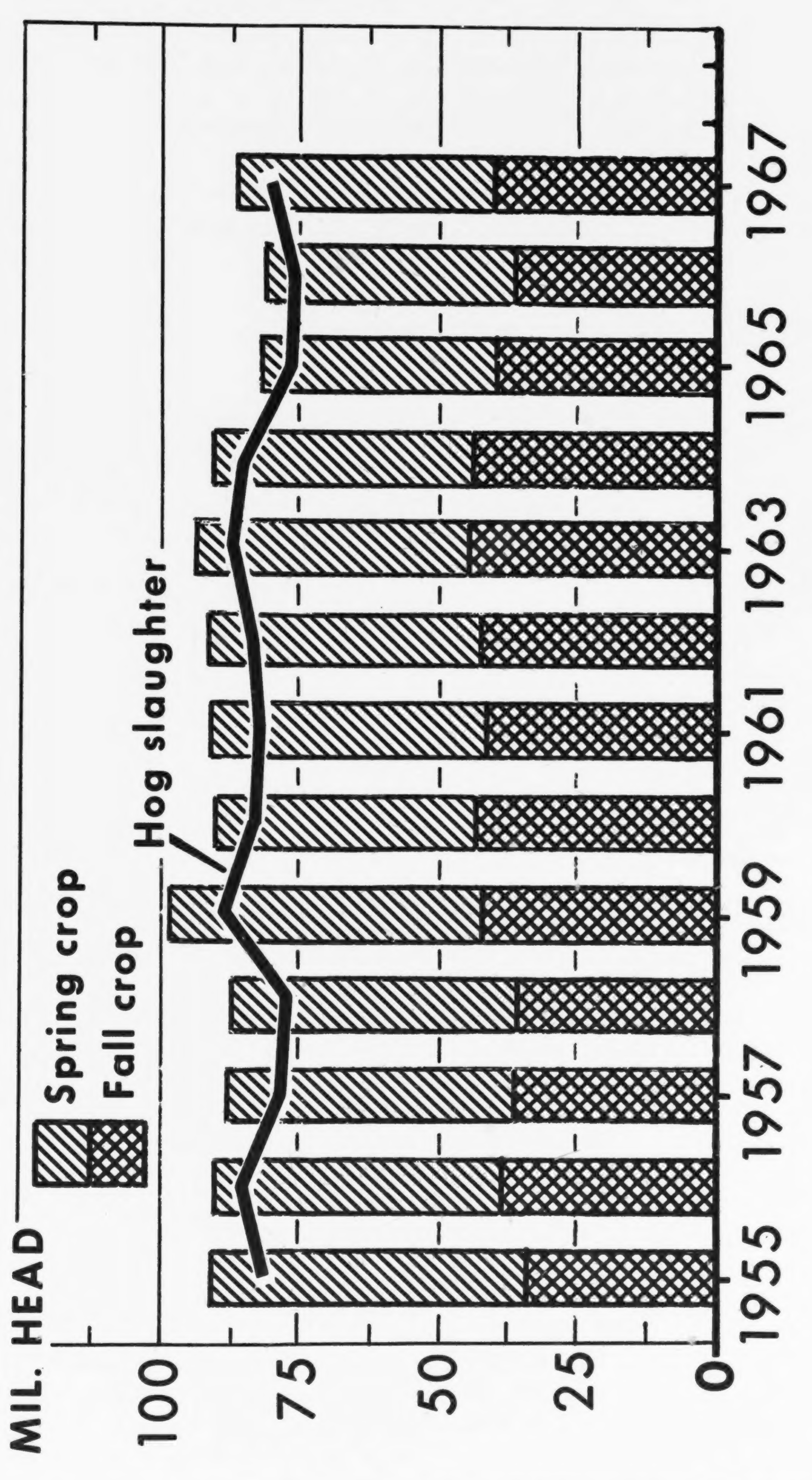
8. About how many people in this county work in the livestock industry for part or all of their living?
    Farmers
    Meat Processors
    Dairy Processors
    Poultry Processors
    Marketing livestock and products - auctions, order buyers, etc.
    Feed Processing
    Feed Sales
    Transportation of livestock
    Other

SUMMARY:

EVALUATION:

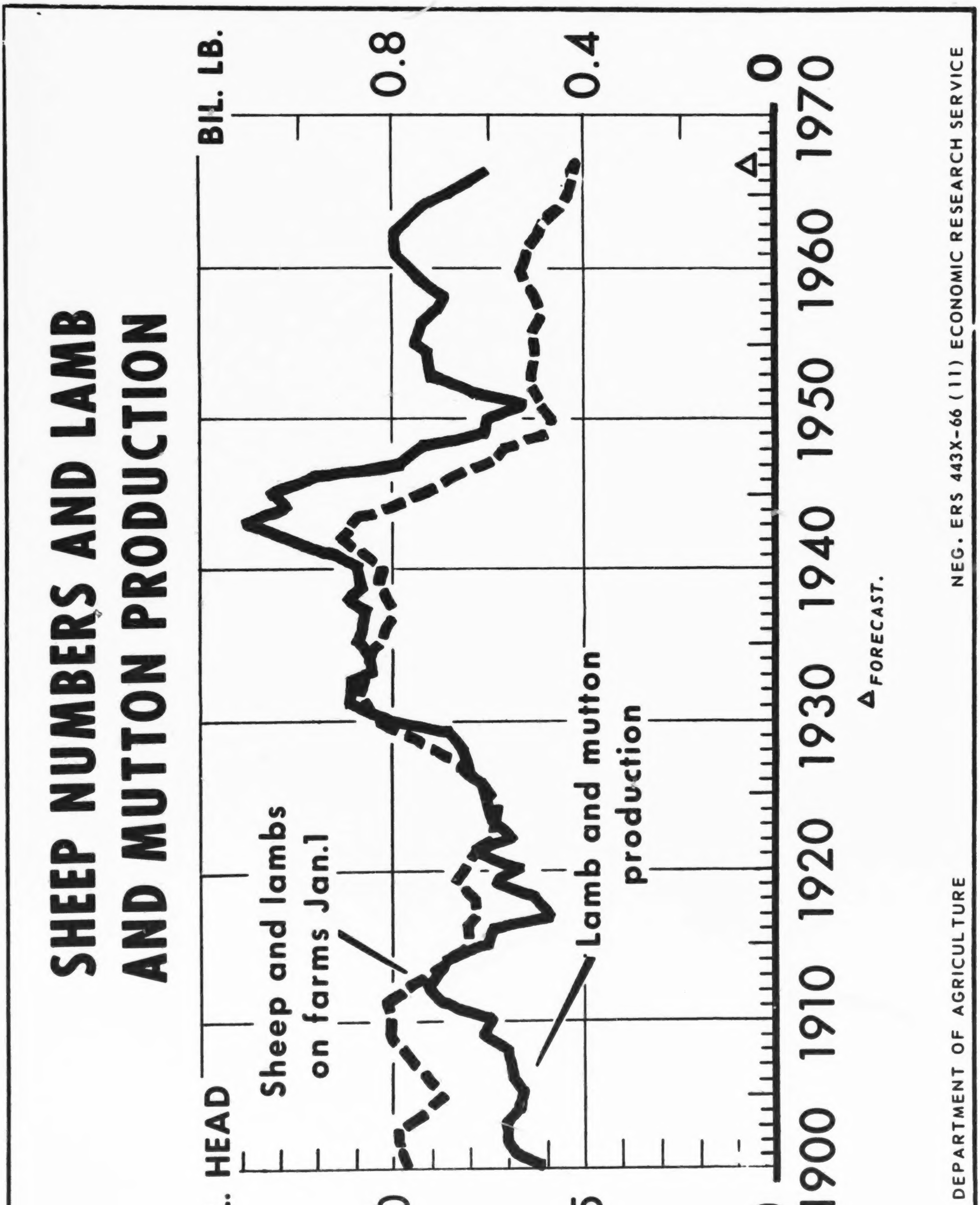
Give a brief test to see if objectives of the subunit were accomplished.

PIG CROP AND HOG SLAUGHTER



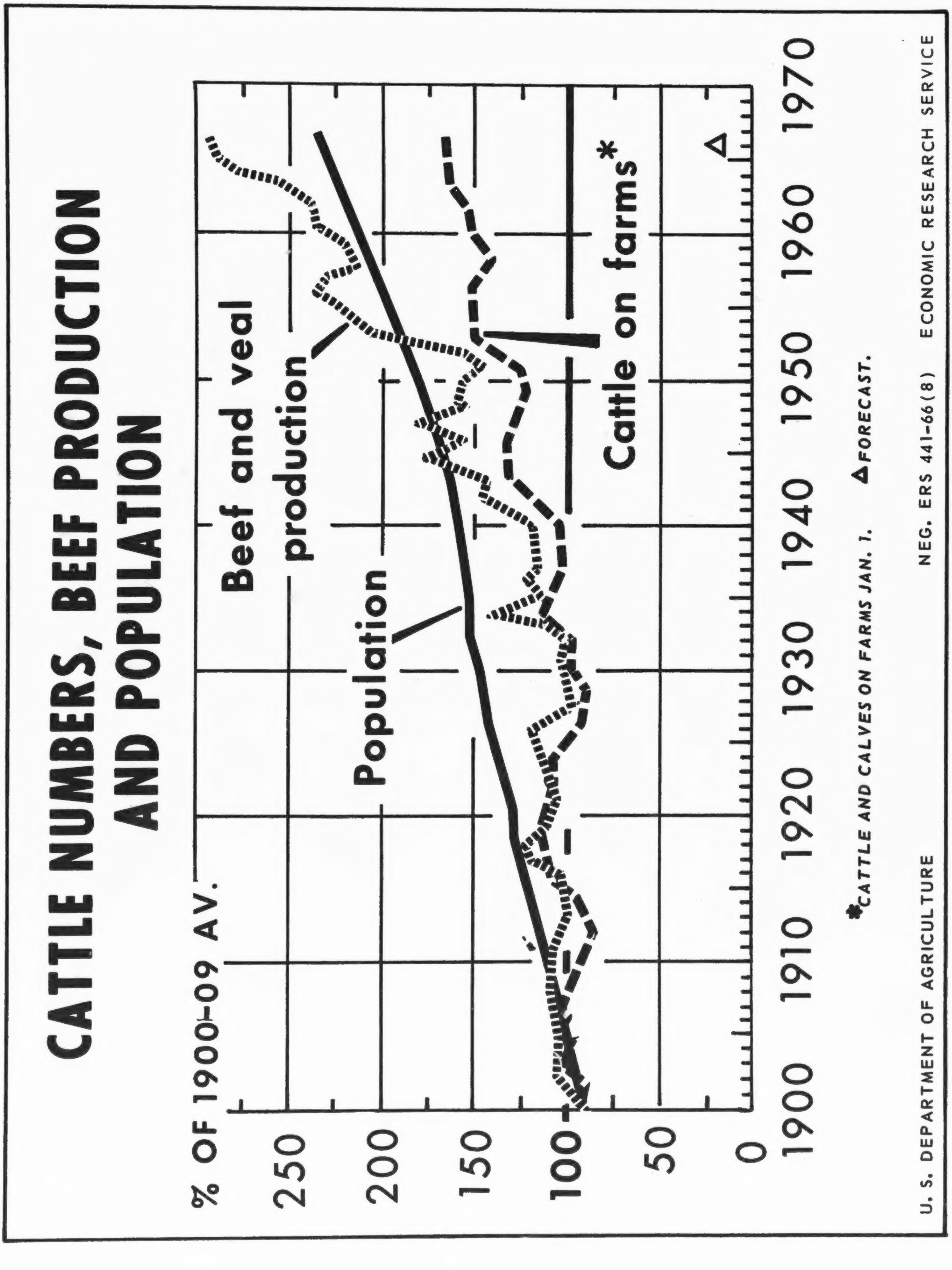
PRECEDING FALL CROP AND SPRING CROP.

U. S. DEPARTMENT OF AGRICULTURE NEG. ERS 4221-67 (1) ECONOMIC RESEARCH SERVICE

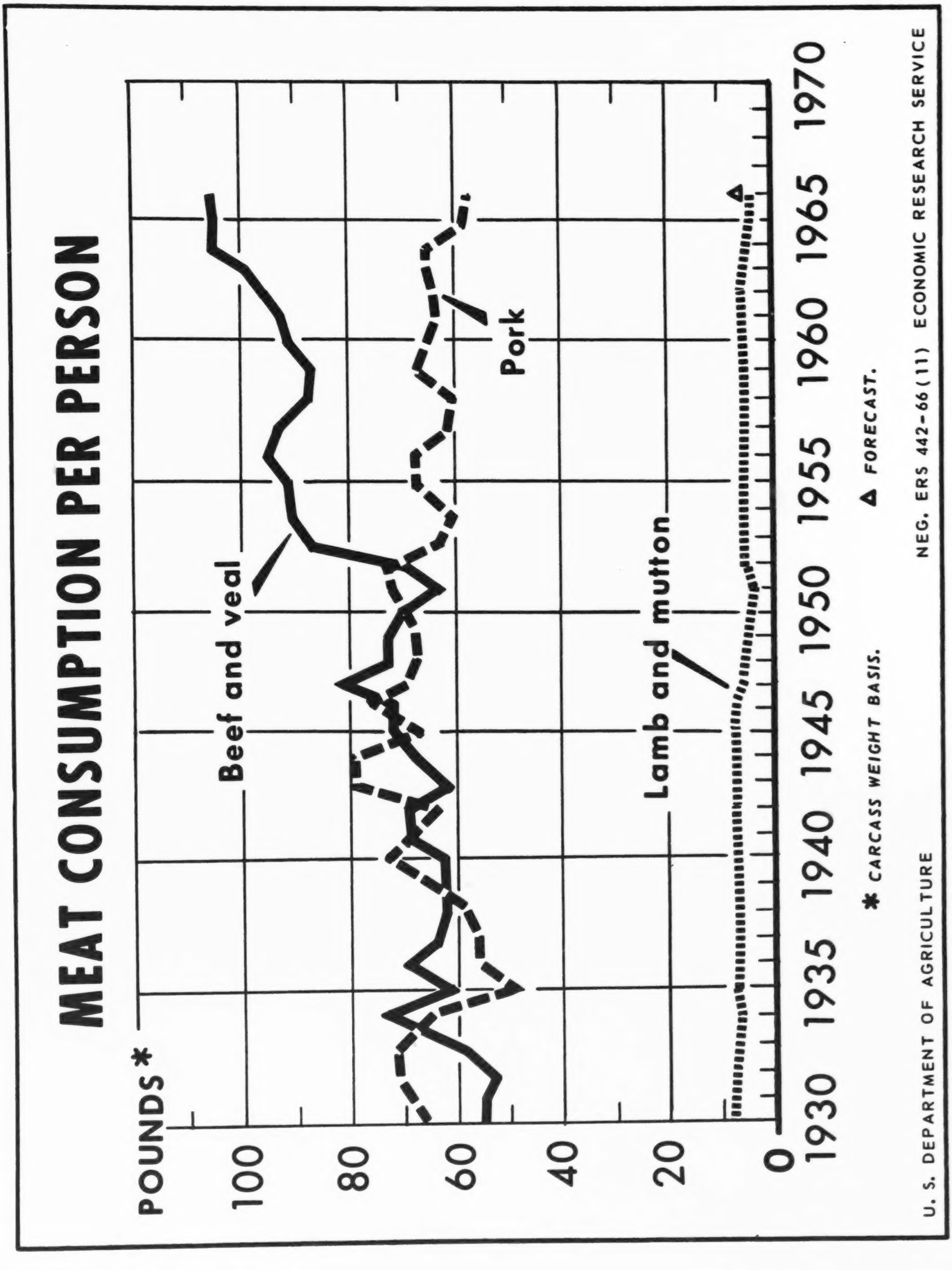


SHEEP NUMBERS AND LAMB AND MUTTON PRODUCTION

U. S. DEPARTMENT OF AGRICULTURE NEG. ERS 443X-66 (11) ECONOMIC RESEARCH SERVICE



CATTLE NUMBERS, BEEF PRODUCTION AND POPULATION

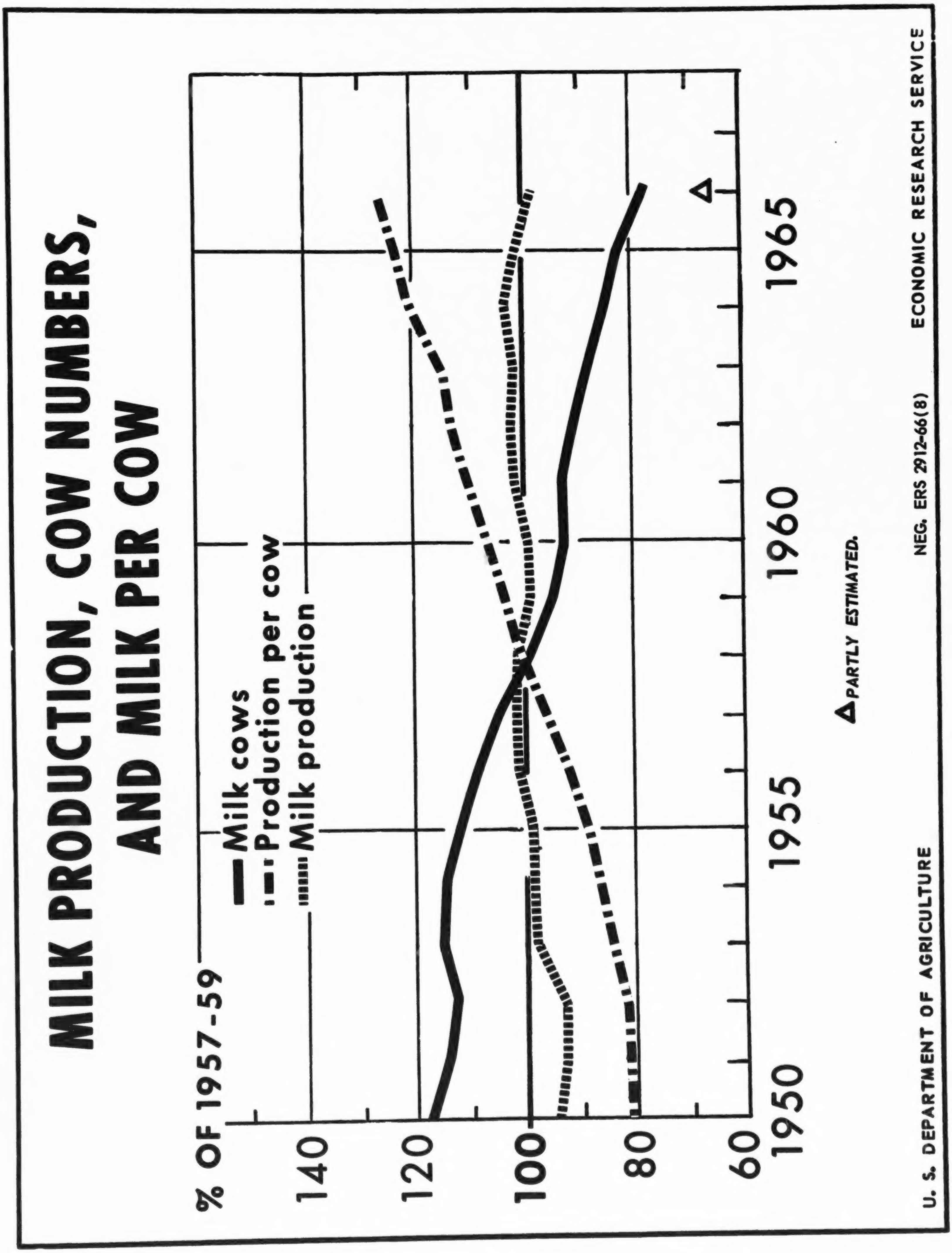


MEAT CONSUMPTION PER PERSON

* CARCASS WEIGHT BASIS.

Δ FORECAST.

U. S. DEPARTMENT OF AGRICULTURE NEG. ERS 442-66 (11) ECONOMIC RESEARCH SERVICE



MILK PRODUCTION, COW NUMBERS, AND MILK PER COW

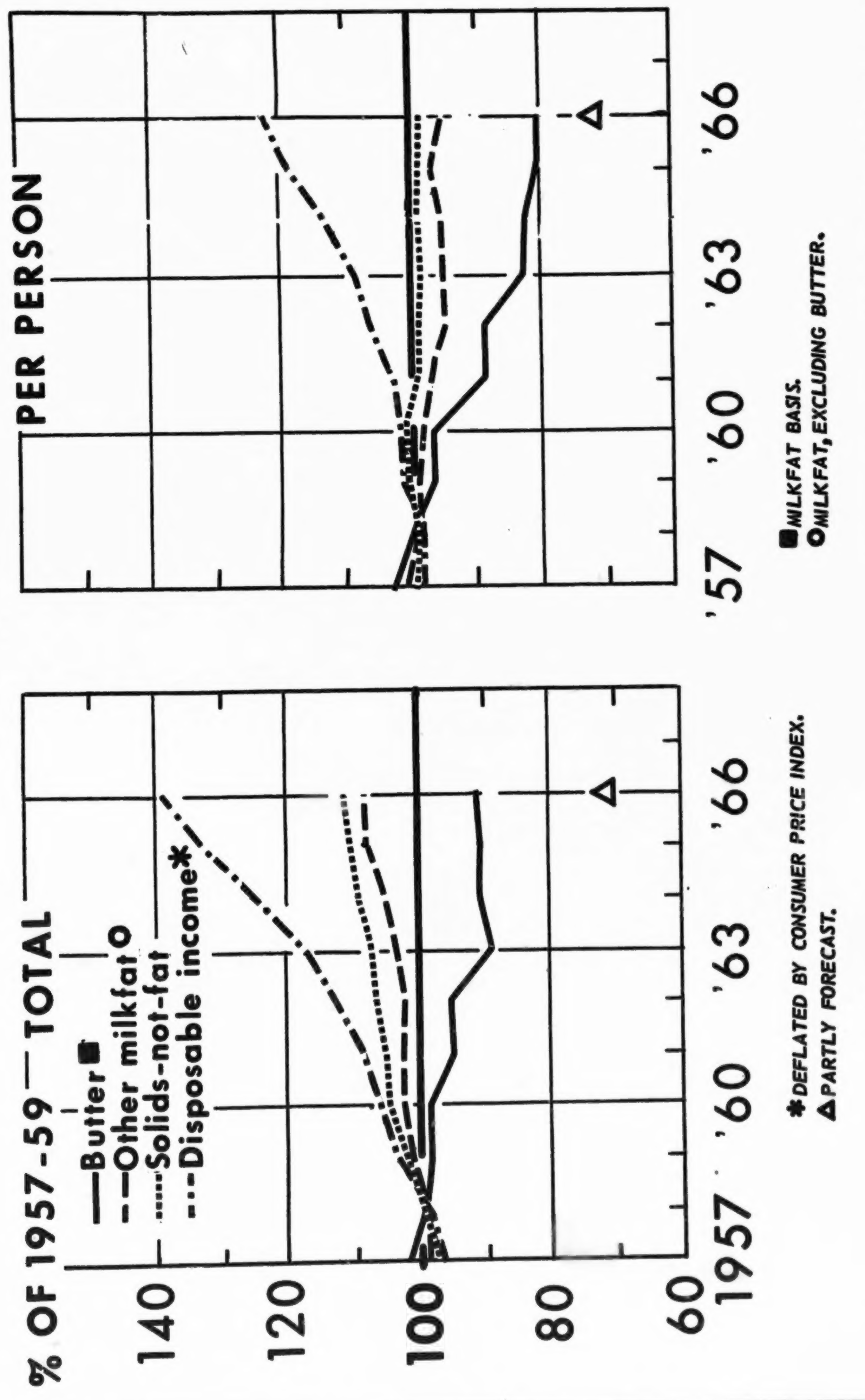
ΔPARTLY ESTIMATED.

U. S. DEPARTMENT OF AGRICULTURE

NEG. ERS 2912-66(8)

ECONOMIC RESEARCH SERVICE

INCOME AND COMMERCIAL CONSUMPTION OF MILK SOLIDS

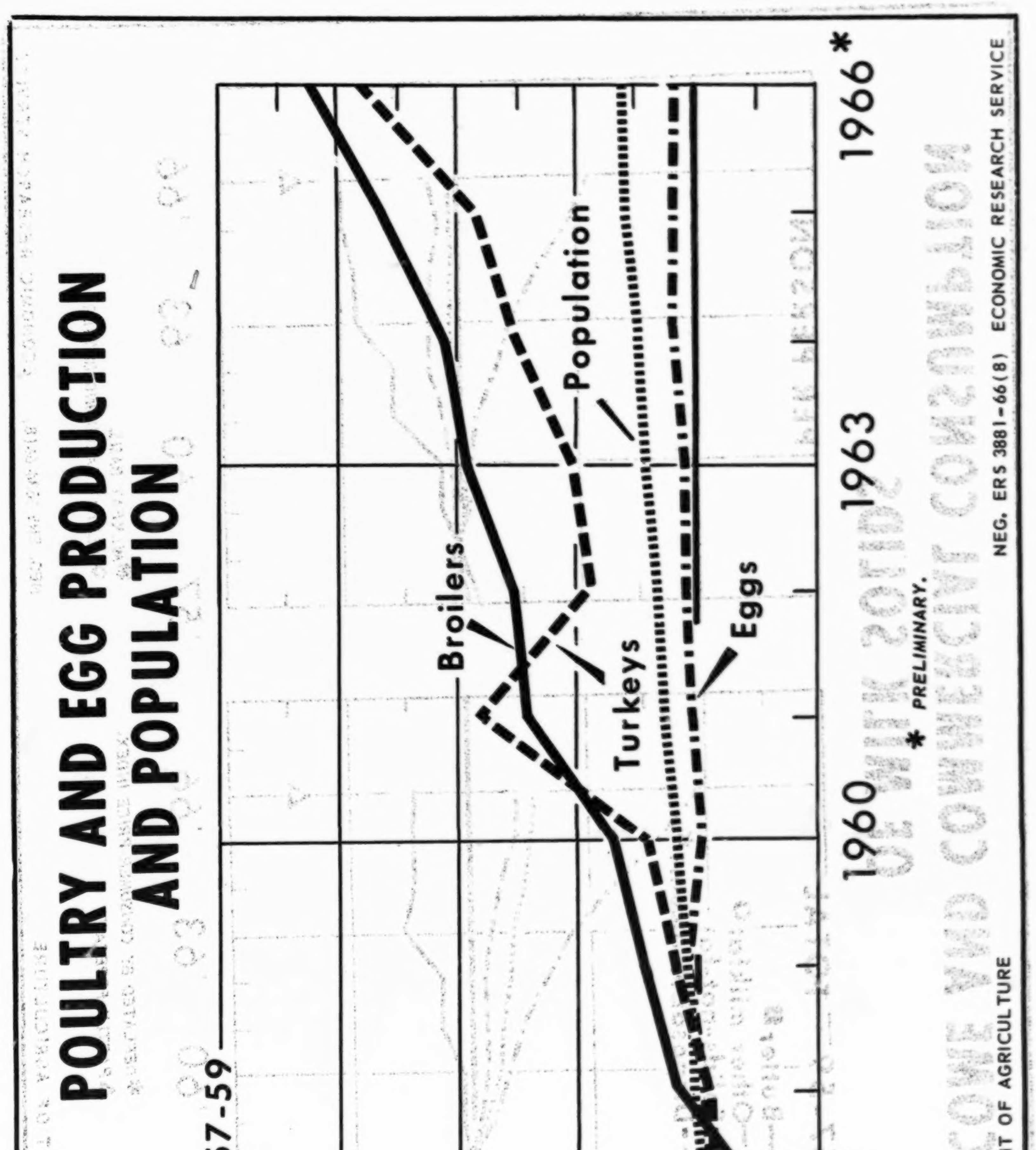


*DEFLATED BY CONSUMER PRICE INDEX.
△PARTLY FORECAST.

■MILKFAT BASIS.
○MILKFAT, EXCLUDING BUTTER.

U. S. DEPARTMENT OF AGRICULTURE NEG. ERS 3834-66(8) ECONOMIC RESEARCH SERVICE

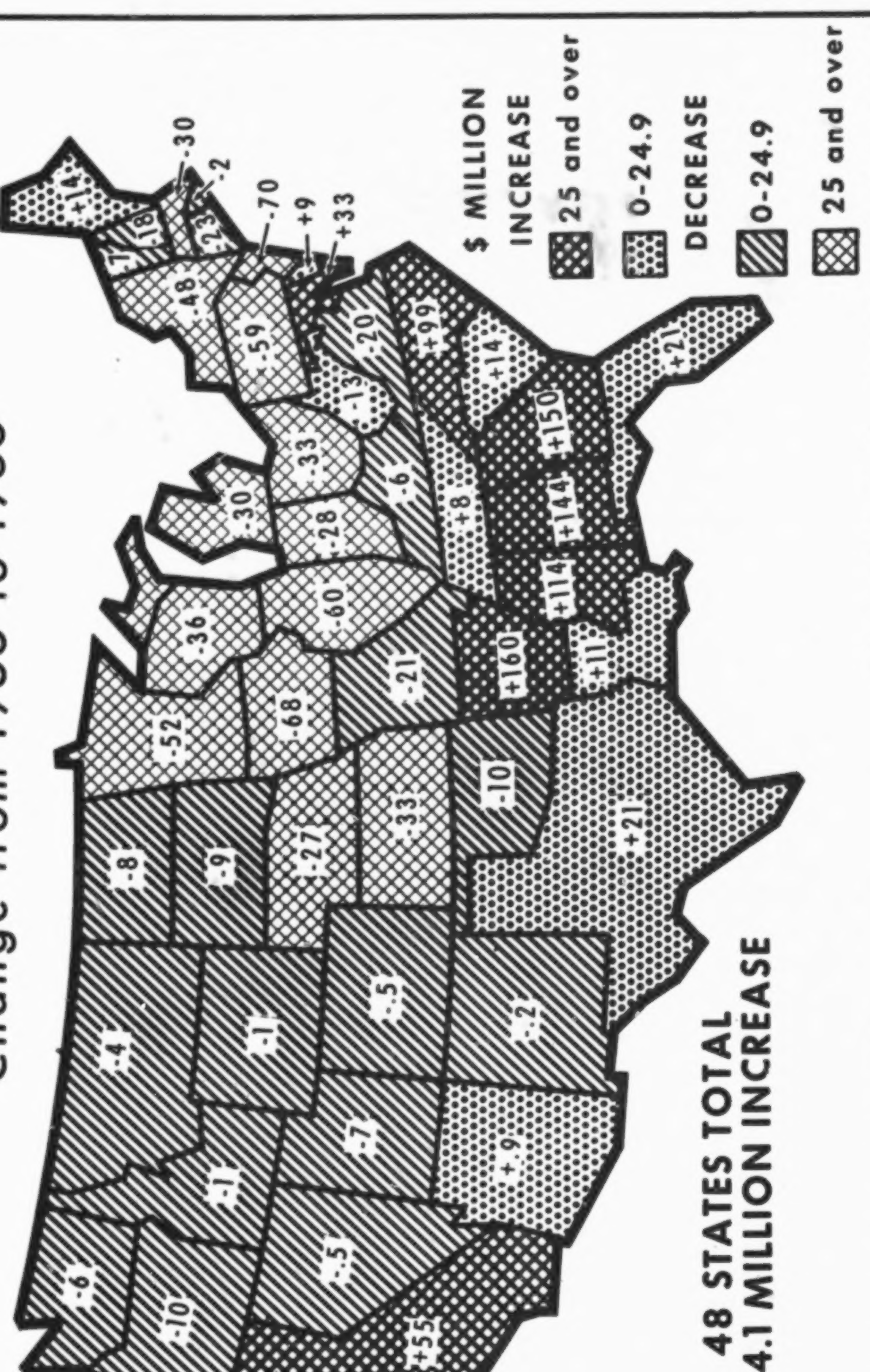
POULTRY AND EGG PRODUCTION AND POPULATION



U.S. DEPARTMENT OF AGRICULTURE NEG. ERS 3881-66(8) ECONOMIC RESEARCH SERVICE

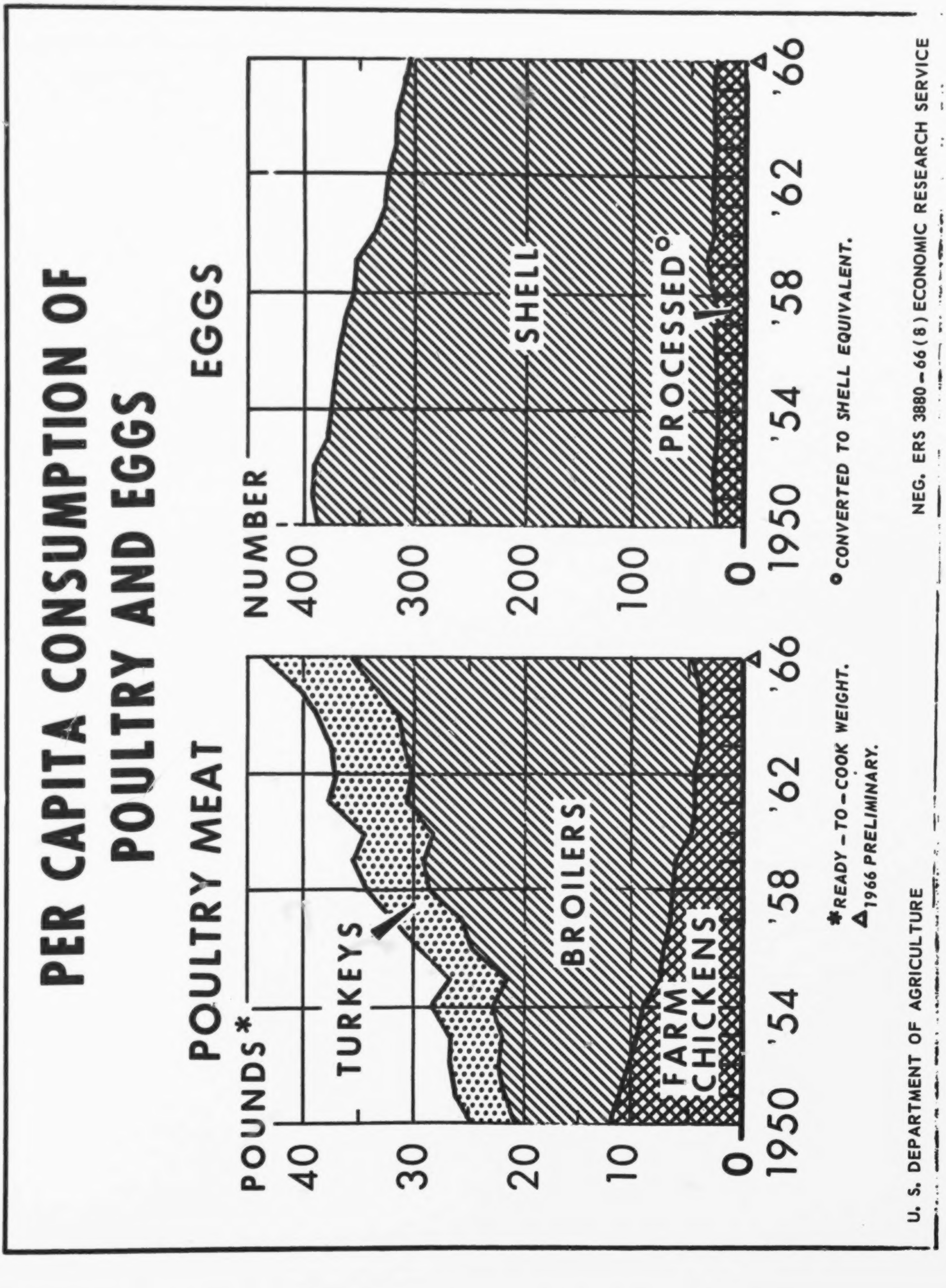
GROSS FARM INCOME FROM POULTRY AND EGGS

Change from 1955 to 1965


$ MILLION
INCREASE
25 and over
0-24.9
DECREASE
0-24.9
25 and over
-6
-10
+55
-1
-5
-4
-1
-7
+9
-5
-2
-8
-9
-27
-33
-10
+21
-52
-68
-21
+160
+11
-36
-60
+114
-30
-28
-8
+144
-33
-6
+150
-13
+14
+99
+21
-59
-20
-48
-17
-18
+14
-30
-2
-23
-70
+9
+33

48 STATES TOTAL
$114.1 MILLION INCREASE

U. S. DEPARTMENT OF AGRICULTURE NEG. ERS 3811-66(8) ECONOMIC RESEARCH SERVICE



PER CAPITA CONSUMPTION OF POULTRY AND EGGS

*READY-TO-COOK WEIGHT.
Δ 1966 PRELIMINARY.

° CONVERTED TO SHELL EQUIVALENT.

U. S. DEPARTMENT OF AGRICULTURE

NEG. ERS 3880-66(8) ECONOMIC RESEARCH SERVICE

Subunit: Livestock Selection 11 days

OBJECTIVES:

1. To learn to fit a livestock program to a farm.
2. To be able to identify principal breeds of livestock grown in Missouri.
3. To understand some general principles of livestock selection.
4. To be able to choose individual animals of one or more classes of livestock intelligently.
5. To become aware of some career opportunities in working with livestock.

MOTIVATION:

Farmers want to own profitable animals of which they can be proud. Those serving farmers would also do well to have some appreciation of what constitutes quality in livestock. What is the farmer's reaction when a salesman fails to recognize an outstanding bull or admires a scrub?

LESSONS:

		Days	Pages
1.	Which Classes of Livestock for My Farm	1	19
2.	General Considerations in Obtaining Suitable Breeding Stock	2	25
3.	Selecting Beef Cattle	2-3	31
4.	Selecting Sheep	2-3	47
5.	Selecting Hogs	2-3	67
6.	Selecting Horses	2-3	85
7.	Selecting Dairy Cattle	2-3	99
8.	Selecting Poultry	2-3	111
9.	Selecting Other Classes of Livestock	3	117
		11	

It is suggested that teachers and their classes choose one 3-day lesson (with field trip) and one 2-day lesson in addition to the first, second and last lessons in the list.

GETTING READY FOR THIS SUBUNIT:

A. References and Materials
   1. Textbooks
      Livestock and Poultry Production
      Animal Science
      Farm Business Planning Guide
      Standard of Perfection
   2. Bulletins and Other Publications
      "Dairy Cow Unified Score Card"
      "Dairy Bull Unified Score Card"
      "Understanding Your DHIA Records"
      "Sample Dairy Herd Improvement Record"
      Poultry Breed Pictures
      "Culling Hens" FB 2216
      "Weeding with Geese," MU Guide 8922
   3. Movies:
      Source: Communications Department
      119 Whitten Hall
      Columbia, Missouri 65201

		Minutes
"The Horse America Made"	Color	18
"Modern Beef Cattle"	Color	20
"More Profit Per Acre"		20

   4. Other Materials
      Large dowel or board about 3' long with one end square for Lesson 2.

B. Advance Arrangements
   1. Decide how to allocate time to this subunit. It is suggested that 3 days be devoted to the enterprise of most interest to the class and 2 days to the next one. Try to have a field trip for practice judging with the 3-day lesson.
   2. The breed associations have some excellent pictures and literature on selection of livestock. The associations are listed with addresses in MU Guide 2906. Ordering from as many of these as interest your class would be a very rewarding endeavor. This is expensive to the associations and I have been asked to suggest you order one set for the department rather than having each student order his own.

Ordering needs to be done well in advance since many associations do not have a full-time staff and your request may be filled several weeks after received.

3. Most teachers will do well to prepare the chart called for in Lesson 1 in advance. Otherwise, you may spend considerable class time trying to find out how to work with the information required.
4. Dr. Alfred Lane, Dairy Extension Specialist, has accompanying slides being prepared. These will be available by contacting him before the fall of 1967.
5. When preparing for Lesson 9 refer to the earlier lesson for the corresponding enterprises. There you will find the transparencies and handouts needed as well as additional suggestions which you may have time to use.

EVALUATION:

Give periodic quizzes over the objective material in the lessons.

Have brief picture-identification quizzes over livestock breeds regularly.

After Lesson 9 give a comprehensive examination over the subunit. Include: breed identification, indications of ideal type in various livestock classes, and some of the general considerations in livestock selection.

Lesson 1. Which Classes of Livestock for My Farm 1 day

OBJECTIVES:

1. To realize the kinds of considerations which influence the choice of livestock for a farm.

2. To discover some important characteristics of the different classes of livestock which influence their adaptability to various farm situations.

REFERENCES:

Farm Business Planning Guide, pages 12 - 14; Tables 11, 12, 13, 14, 15, 16, and 17.

		Page
Transparencies:	"Animals Required To Earn $3000"	21
	"Factors To Consider When Selecting Livestock Enterprises"	22
Handout:	"Requirements To Earn $3000"	23

MOTIVATION:

How do you think a farmer should decide what livestock enterprises to include?

OUTLINE:

A. Profit expected

B. Labor available

C. Feed available

D. Capital available

E. Buildings and equipment available

F. Personal preference of the operator

PROCEDURES:

1. Assume that a farm operator needs to make $3000 from livestock. How many of each of the various classes of livestock would be required to give this much income? Have the class work one example with you. Then, show "Animals Required to Earn $3000." Be sure they understand that the figures were derived from Tables 11 - 17.

Divide the following assignment so each person has only one or two classes to figure. Have them determine:

1. How many hours of direct labor would be required to return the $3000 by the various classes? (Table 6)
2. How many dollars of interest capital would be required for each of the classes. Read the first sentence on page 20 of Farm Business Planning Guide to indicate what is meant by total capital and interest capital. (Table 2)
3. How many bushels of corn equivalent would be required for each? (Tables 11 - 17)
4. How many tons of hay equivalent would be required for each? If forage yield averaged 2 tons per acre, how many acres would be required to produce the forage. (Tables 11 - 17)

   Use the sheet "Requirements to Earn $3000" for each group to report data. Limit study time or assign out-of-class study. Fill in blanks using the transparency; permit students to fill in their own sheets.

2. There are many ways to make $3000 from livestock. How do we decide which is the best one for a given farm? Show "Factors To Consider When Selecting Livestock Enterprises." Discuss.

SUMMARY:

ANIMALS REQUIRED TO EARN $3,000*

	Head**
Dairy cows (12,000 lb. milk)	
Fluid milk	12
Manufacturing milk	19
Sows (8 pigs raised)	
Butcher hogs	33
Feeder pigs to 60 lb.	51
Beef cows (450 lb. calf sold)	104
Steer calf (wintered on silage, then finished)	167
Steer calf (finished immediately)	188
Steer calf (wintered, grazed, finished)	77
Laying hens	2,956
Broilers (contract)	10,205
Turkeys	593

*Return to Labor, Capital and Fixed Costs.
**Rounded up to next whole number.
(Top management level used for dairy, hens and turkeys; middle level for beef and hogs, Tables 11 - 17)

FACTORS TO CONSIDER WHEN SELECTING LIVESTOCK ENTERPRISES:

1. Amounts of grain and forage crops produced in the cropping system.
2. Regularity and stability of net income required.
3. Amount of labor available.
4. Distribution of labor requirements for livestock during the year as compared to the crop labor requirements.
5. Skill and personal likes of the manager.
6. Available markets.
7. Capital requirement and rapidity of capital turnover.
8. Profit required.

REQUIREMENTS TO EARN $3,000

	Head	Labor (hours)	Capital ($)	C.E.[1] (bushels)	H.E.[2] (tons)
Fluid milk	12				
Manufacturing milk	19				
Butcher hogs	33				
Feeder pigs	51				
Beef cows	104				
Steers (wintered on silage, then finished)	167				
Steers (finished immediately)	188				
Steer calf (wintered, grazed, finished)	77				
Laying hens	3*				
Broilers (contract)	2**				
Turkeys	1*				

[1] Corn Equivalent
[2] Hay Equivalent
*Nearest 1,000
** Nearest 5,000

Lesson 2. General Considerations in Obtaining Suitable Breeding Stock

2 days

OBJECTIVES:

1. To discover some of the elements of livestock selection which are common to all classes.

2. To understand the importance of livestock selection to farmers.

REFERENCES:

Livestock and Poultry Production, pages 78 - 80, Hogs; 202 - 204, Beef; 311 - 312, 319, Dairy; 438 - 441, Sheep; 567 - 570, Chickens; 670, 672 - 673, Pedigrees.

Animal Science, pages 73 - 77, General; 428 - 438, Beef; 620 - 627, Sheep; 815 - 820, Swine; 1014 - 1017, Horses. (These reading assignments tend to repeat the same information with specific applications to each class of livestock. It is recommended that assignments be divided among students based upon their interests.)

Transparency:	Page
"This or This"	29

MOTIVATION:

Each of us will want to select desirable individual animals whether for our own farm or to test our skill against the judge's placings at the fair. Before we practice judging skill, however, we ought to see what some of the general features of profitable livestock are. It is surprising how many of these apply to all classes of livestock.

OUTLINE:

A. Physical appearance - attractiveness and usefulness.
    1. Straight legs for long, useful life
    2. Ruggedness - strong bone, wide chest, sufficient body capacity
    3. Conformation - based on use
        a. Meat animals - blocky, high proportion of high priced cuts
        b. Dairy - streamlined for milk production
        c. Egg layers - streamlined for egg production

B. Show-ring performance

C. Production and performance records
   1. DHIA
   2. USROP
   3. Certified meat hogs
   4. Performance-tested beef

D. Pedigree

E. Other Factors
   1. Health
   2. Uniformity
   3. Reproductive ability
   4. Ability to rear young
   5. Price
   6. Registered, PB, grade, crossbred, scrub
   7. Age and longevity

PROCEDURES:

1. What are our reasons for keeping livestock? Who cares whether the rear end of a steer looks like this or like this. Show "This or This". Cover up the good one at first. Why is the housewife so important when we are deciding how our livestock should look? Discuss these questions so students realize we produce livestock for market and the market makes demands upon the producer. Some students may point out correctly that we keep livestock for recreational purposes too. Who decides what the appearance of recreational animals should be? Show pictures of animals which point out their attractiveness and usefulness.

2. Set a long dowel or board on the floor. What holds it up? Then, tip the dowel about 10°. What holds it up now? (Muscle - yours!) Can we think of an analogy emphasizing the importance of straight legs on livestock? Why are they more important on breeding stock than on feeder stock?

3. We would like for livestock to be rugged enough to avoid injuries and disease. Can you think of some evidences of ruggedness in men? Would some of these same evidences be good clues that livestock would remain healthy and active for a long time?

4. Why is a good dairy cow shaped differently than a good beef cow? A good laying hen vs. a good broiler chicken? A good wool sheep vs. a good mutton sheep? What can we say as a generalization about the relationship between correct conformation and the purposes for which we keep animals? Show pictures or transparencies from the following lessons to emphasize how ideal shapes of beef and dairy, etc. differ.

5. Champion Gladiator XXIII won first place at the county fair. Would you buy him? What questions would you want answered before you were ready to decide what he was worth? What value is there in show ring performance as a basis for selecting animals? How do fairs and shows contribute to the improvement of livestock?

6. If you get a date to Barnwarming you want a pretty girl. You might also hope she will be a good conversationalist, interested in you, a good dancer, etc. Can you be sure about all of these things before you ask her?

   If you buy an automobile, you want a lot of qualities, all of which indicate good performance. Can you be sure you will be getting all of these when you decide upon your car?

   Persons who purchase livestock have a similar problem in that they would like to know before they spend their money how much milk a cow will produce, how fast calves will gain, how efficiently lambs will gain, how many pigs a sow will raise or how many eggs and of what quality a hen will lay in a year. Is there any way to improve our chances of selecting animals that will perform well other than by looking at them?

   Scientists have, in fact, spent much time and effort trying to help predict the future performance of animals and their offspring. Some of the programs now being employed include Certified Meat Hogs, Dairy Herd Improvement Association, U. S. Record of Performance for chickens and performance testing of hogs and beef at various testing stations.

   Discuss how one or more of these operates.

7. Do you know a family in which most of the members are large for ther age? Small for their age? Are there some exceptions?

   You know, of course, that a person's size is partially determined by inheritance. This is true of all other characteristics of individuals and it is so for our livestock as well as for people.

Laws of inheritance are pretty well understood by purebred livestock breeders. Even though there are bound to be exceptions we can predict something of the character of offspring if we know enough about the ancestors.

Discuss the pedigree on pages 672 - 673 of Livestock and Poultry Production. What is a pedigree? Of what value is it?

How much would it be worth to learn that the great grand sire of an animal was a truly outstanding individual if nothing was known about the conformation or performance of any of the other animals in the pedigree? Discuss the other factors (E in Outline) influencing selection of livestock. Be sure students know the meaning of each and to which classes of livestock they are especially applicable.

SUMMARY:

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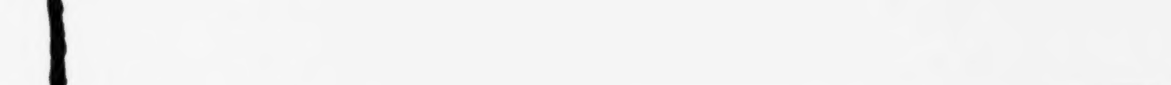

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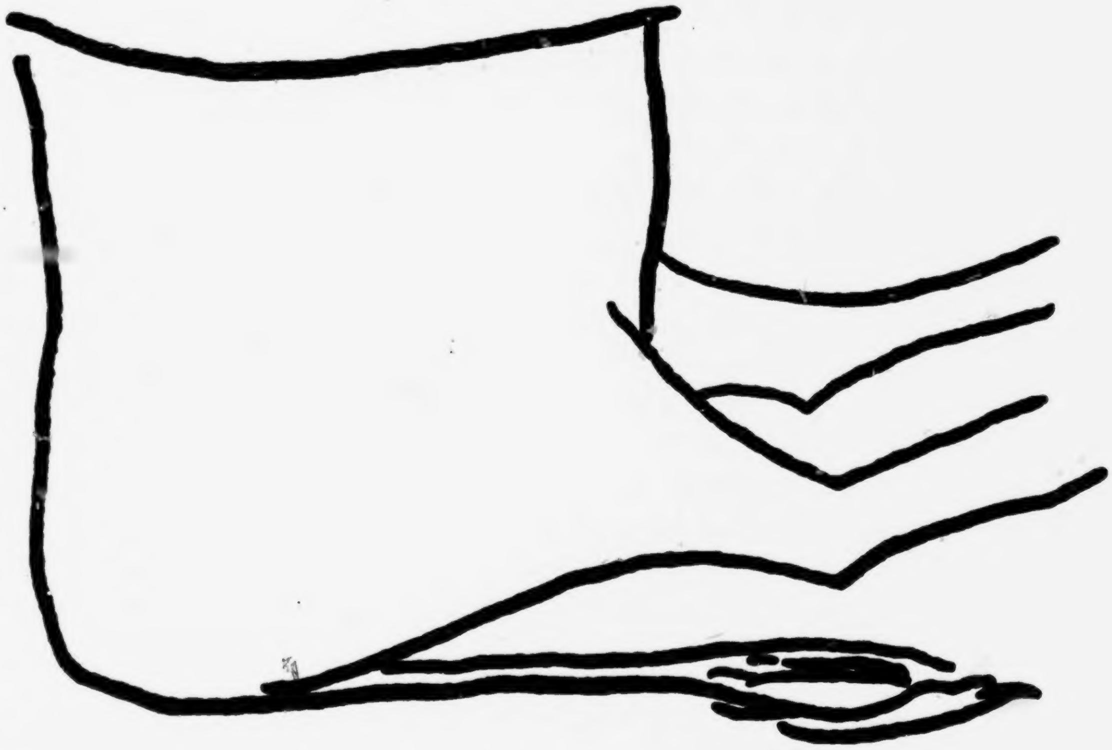

Lesson 3. Selecting Beef Cattle

2 days and 1 day field trip

OBJECTIVES:

1. To recognize ideal beef type.
2. To be able to identify principal parts of beef animals so as to discuss the animals intelligently.
3. To recognize principal breeds of beef cattle.

REFERENCES:

Breed association pictures and literature

Livestock and Poultry Production, pages 187 - 212

Animal Science, pages 438 - 444; also Chapter X.

		Page
Handouts:	"Parts of a Beef Animal"	36
	"Beef Breed Characteristics"	45 - 6

		Page
Transparencies:	"Parts of Beef Animal"(unlabeled)	35
	"Parts of Beef Animal"	36
	"Wholesale Cuts of a Beef Carcass"	37
	"Major Parts of Beef Animal"	38
	"Side View--Ideal Type"	39
	"Rear View--Ideal Type"	40
	"Front View--Ideal Type"	41
	"Common Faults--Side View"	42
	"Common Faults--Rear View"	43
	"Common Faults--Front View"	44

MOTIVATION:

There is understandable pride in owning a quality animal. (Show a picture of one). Also, quality animals make more money for their owners. Why?

OUTLINE:

A. Parts of a Beef Animal

B. Wholesale Cuts of a Beef Carcass

C. Major Parts of a Desirable Beef Animal

D. Ideal Conformation of a Beef Animal
   1. Side View
      a. large, early maturing
      b. balanced and symmetrical
      c. great depth of body
      d. short coupled
      e. low-set
      f. straight top and bottom lines
      g. blocky
      h. deep, full quarters
      i. a short, thick neck
      j. full, thick crops
      k. straight, true, and squarely set legs
      l. ample bone, with quality
      m. quality and smoothness
      n. style and breed type
   2. Rear View
      a. uniformly wide from front to rear
      b. wide over top
      c. trim in the middle
      d. level rump
      e. wide, deep, full quarters
      f. legs set wide apart
   3. Front View
      a. shapely head, short face, broad forehead, and wide muzzle
      b. femininity and masculinity
      c. wide, rounded, neat, and trim
      d. wide chest
      e. correctly set front legs

E. Common Faults in Conformation
   1. Side View
      a. undersized
      b. lacking in balance and symmetry
      c. shallow bodied
      d. long bodied
      e. upstanding
      f. easy in back, high in flanks
      g. angular
      h. light in quarters
      i. long necked
      j. slack in crops
      k. crooked legs; sickle hocked, cow hocked, too straight in hocks

        - l. coarse boned
        - m. rough or coarse
        - n. lacking in style and breed type
    - 2. Rear View
        - a. narrow bodied
        - b. lacking width over top
        - c. paunchy
        - d. sloping in rump
        - e. lacking width, depth, and fullness of quarters
        - f. cow hocked
    - 3. Front View
        - a. plain head
        - b. lacking femininity and masculinity
        - c. too heavy and wasty in brisket
        - d. narrow chest
        - e. crooked front legs, or twisted bones or feet

F. Important Breed Characteristics

PROCEDURES:

1. Discuss importance of knowing the names of parts so we can talk about good and bad parts of animals and all be describing the same thing. Show the transparency "Parts of a Beef Animal" and let students label as many as they can correctly. Give students the unlabeled handout sheet. Then show the labeled transparency and have students finish labeling their handout. Tell them how many of the parts you expect them to learn and how soon.

2. Show the transparency "Wholesale Cuts of a Beef Carcass." Discuss the relative value of the various parts. (Current prices obtained from your local butcher would add interest.) Why is it important for us as livestock producers and judges to know that T-Bone steak is worth more than brisket and where each is located on a live animal?

3. Show the transparency "Major Parts of a Beef Animal." To what extent are the expensive cuts of meat reflected in these desirable characteristics?

4. Show "Side View--Ideal Type." Follow D. 1 in Outline to point out desired characteristics.

5. Show "Rear View--Ideal Type." Follow D. 2 in Outline to point out desired characteristics.

6. Show "Front View--Ideal Type." Follow D.3 in Outline to point out desired characteristics.

7. Show "Common Faults--Side View." Follow E. 1 in Outline to describe and point out the faults. Show ideal rear view again to emphasize correct type.

8. Show "Common Faults--Front View." Follow E.2 in Outline to describe and point out the faults. Show ideal front view again to emphasize correct type.

9. Show "Common Faults--Front View." Follow E. 3 in Outline to describe and point out the faults. Show ideal front view again to emphasize correct type.

10. Again show the transparency "Major Parts of a Beef Animal" and emphasize that it is really the big things the count most. Refer to the transparency on wholesale cuts again and be sure students feel confident they understand the essential make-up of an ideal animal. Give them the handout "Major Parts of a Beef Animal."

11. There are breed differences. Show pictures of common beef breeds. Briefly discuss which breed is best, then handout the sheet "Beef Breeds." Tell students how much of this you expect them to learn.

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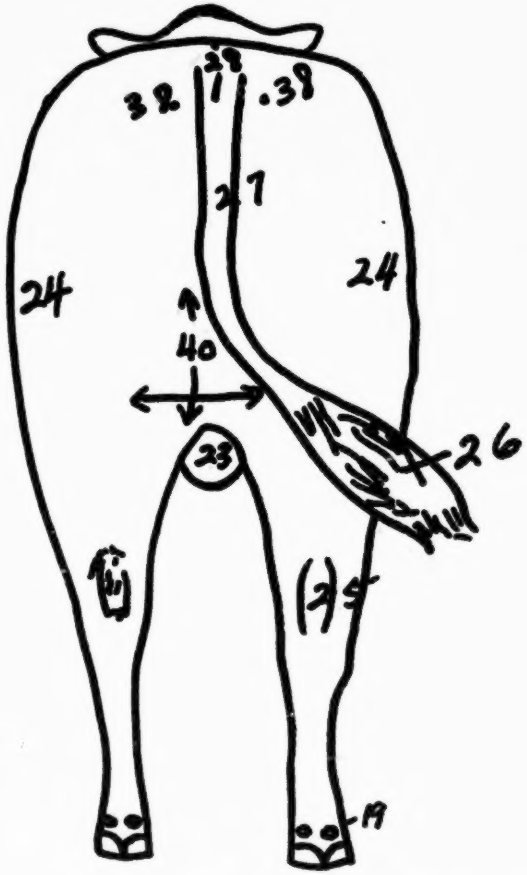
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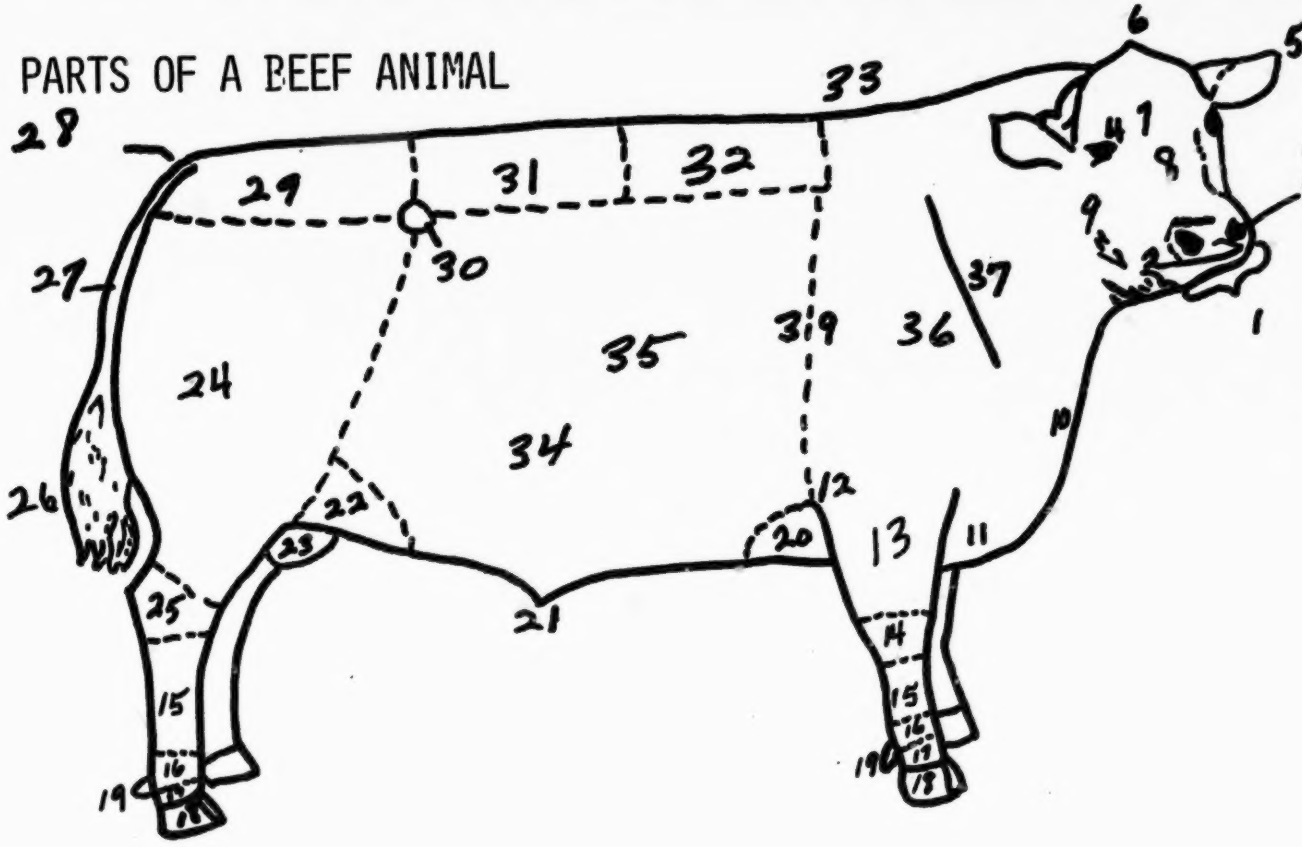
PARTS OF A BEEF ANIMAL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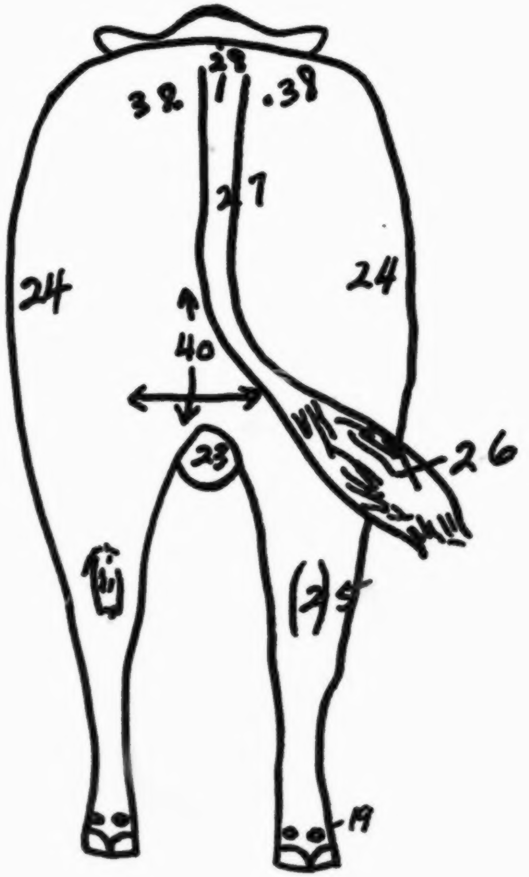
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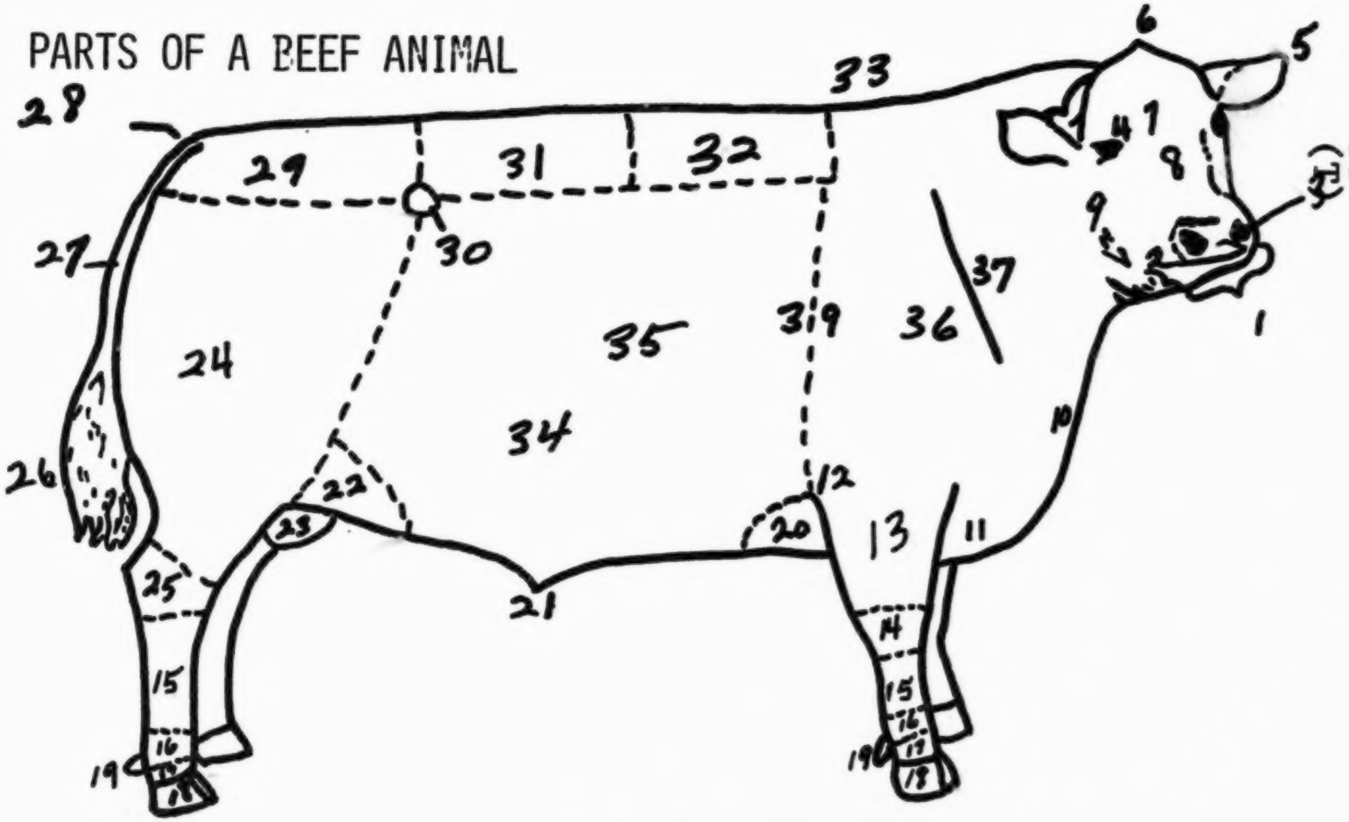
PARTS OF A BEEF ANIMAL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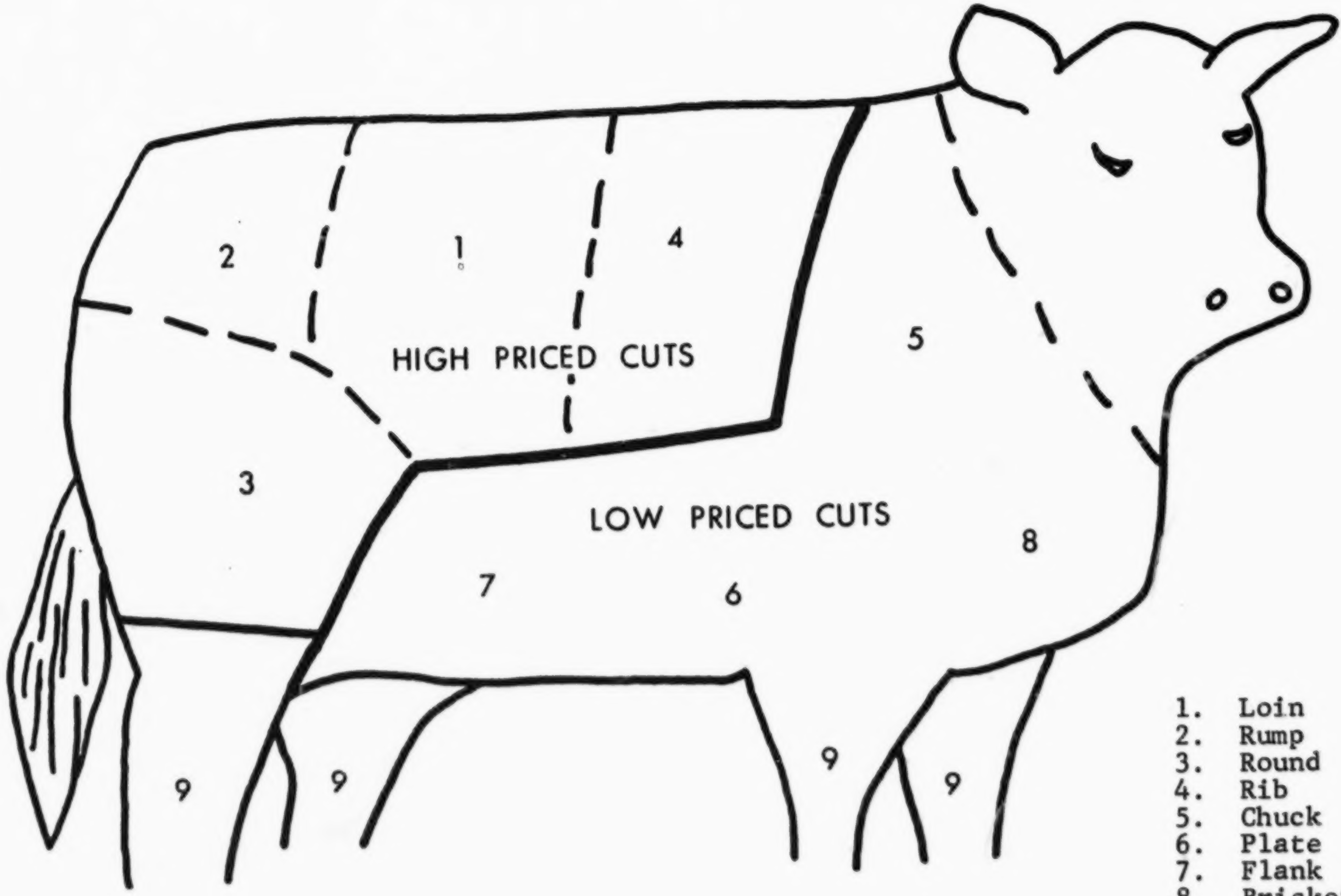
1	MUZZLE
2	MOUTH
3	NOSTRIL
4	EYE
5	EAR
6	POLL
7	FOREHEAD
8	FACE
9	JAW
10	DEW LAP
11	BRISKET
12	ELBOW
13	FOREARM
14	KNEE
15	SHANK
16	PASTERN JOINT OR ANKLE
17	PASTERN
18	TOE OR HOOF
19	DEW CLAW
20	FORE FLANK
21	PENIS AND SHEATH
22	HIND FLANK
23	COD
24	ROUND OR THIGH
25	HOCK
26	SWITCH
27	TAIL
28	TAIL HEAD
29	RUMP
30	HOOK
31	LOIN
32	BACK
33	TOP OF SHOULDERS
34	PAUNCH OR BELLY
35	RIBS
36	SHOULDER
37	SHOULDER VEIN
38	PIN BONES
39	HEART GIRTH
40	TWIST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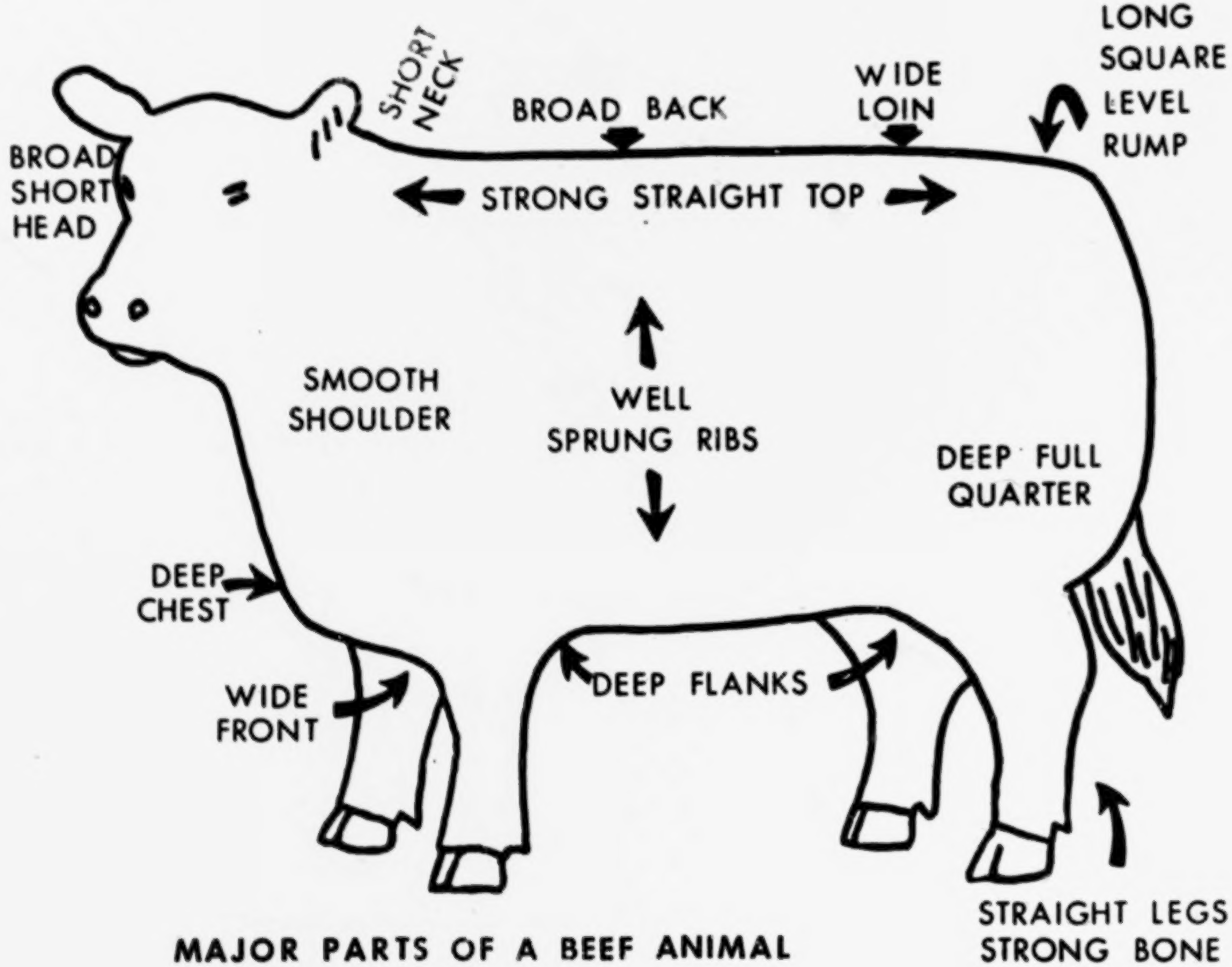
1. Loin
2. Rump
3. Round
4. Rib
5. Chuck
6. Plate
7. Flank
8. Brisket
9. Shank

WHOLESALE CUTS OF A BEEF CARCASS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SPRUNG RIBS
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WIDE
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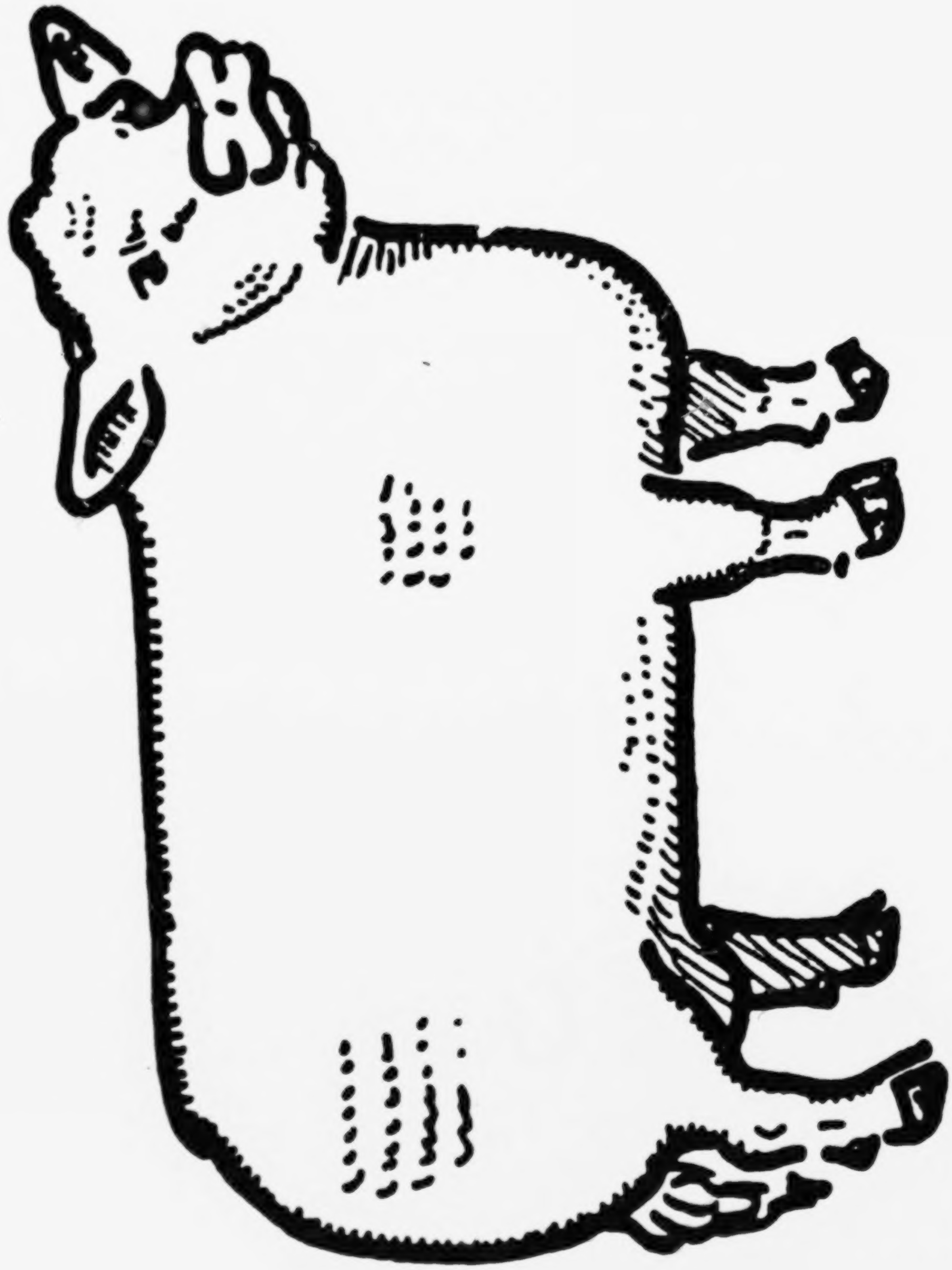
DEEP FLANKS
STRAIGHT LEGS
STRONG BONE

MAJOR PARTS OF A BEEF ANIMAL



Ideal Type--Side View

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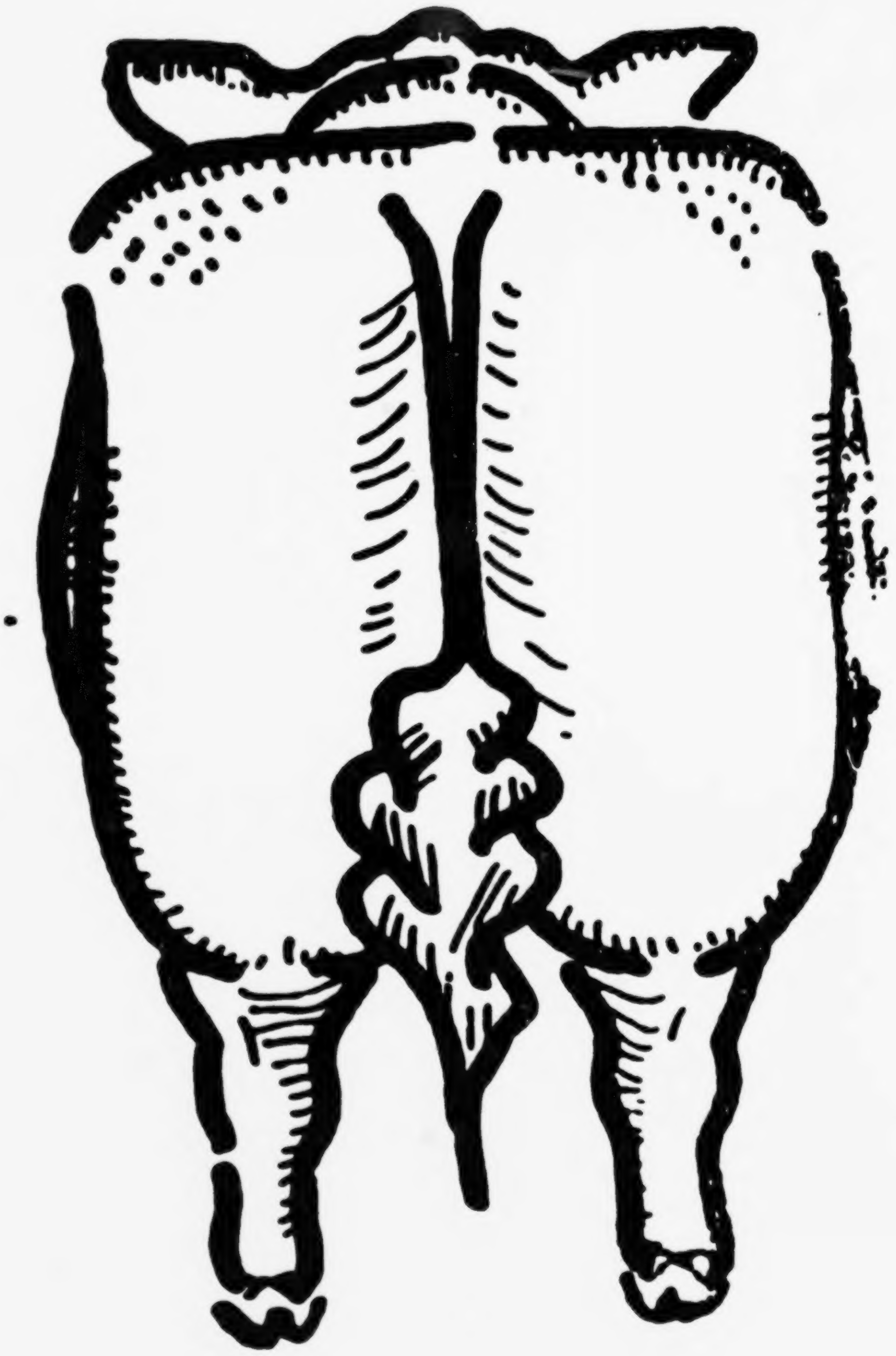
Ideal Type--Rear View



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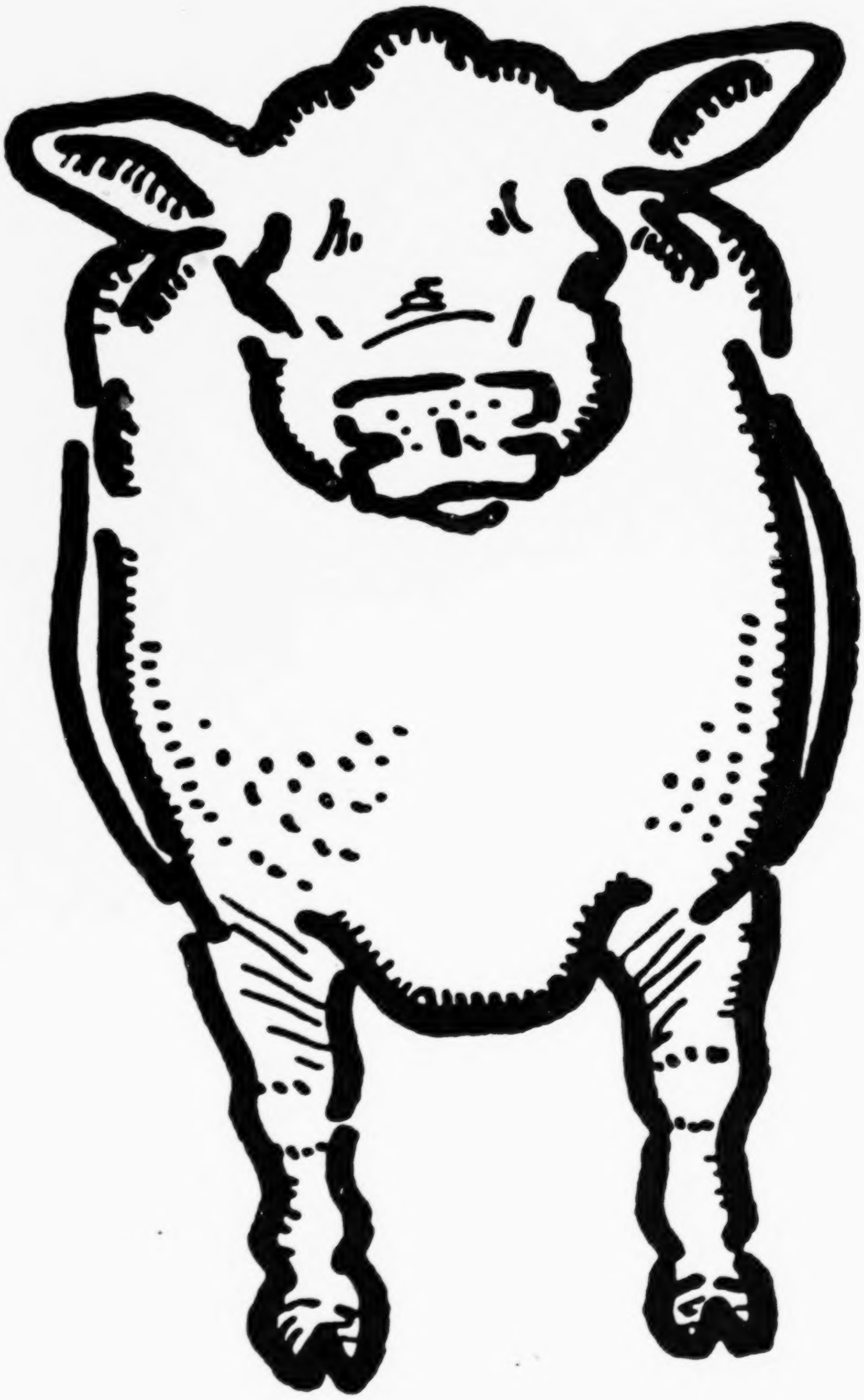
Ideal Type--Front View



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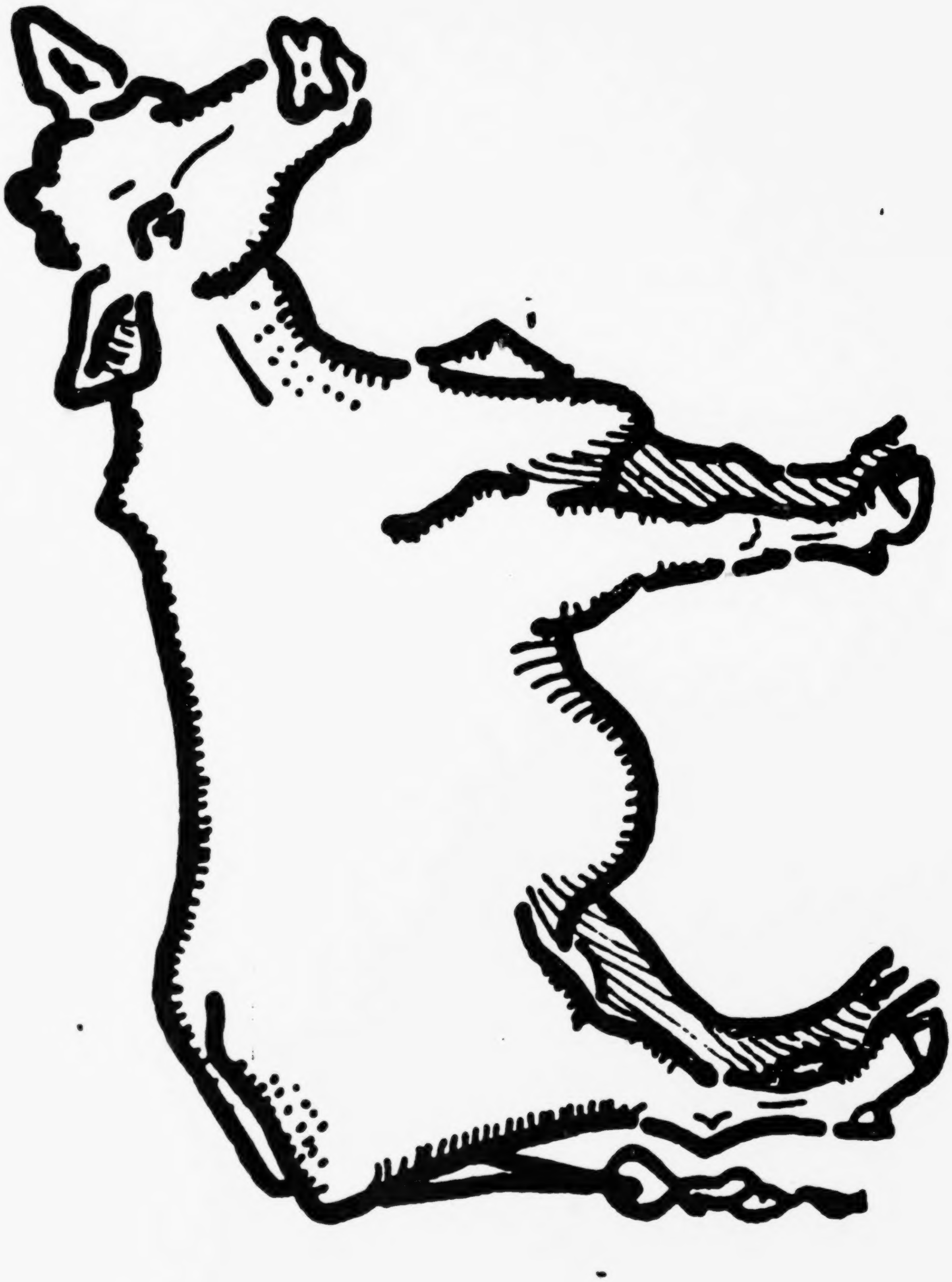

Common Faults--Side View

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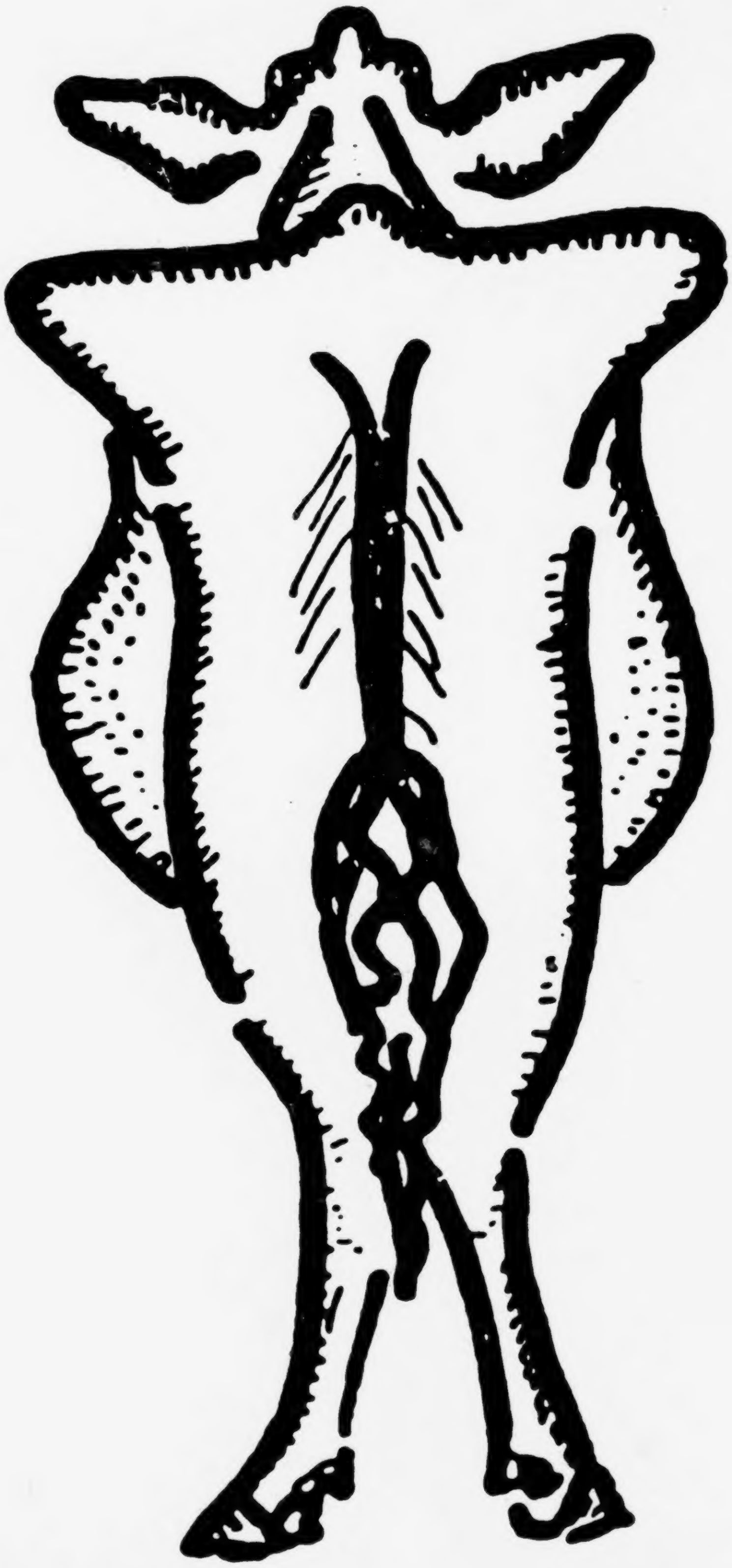
Common Faults--Rear View



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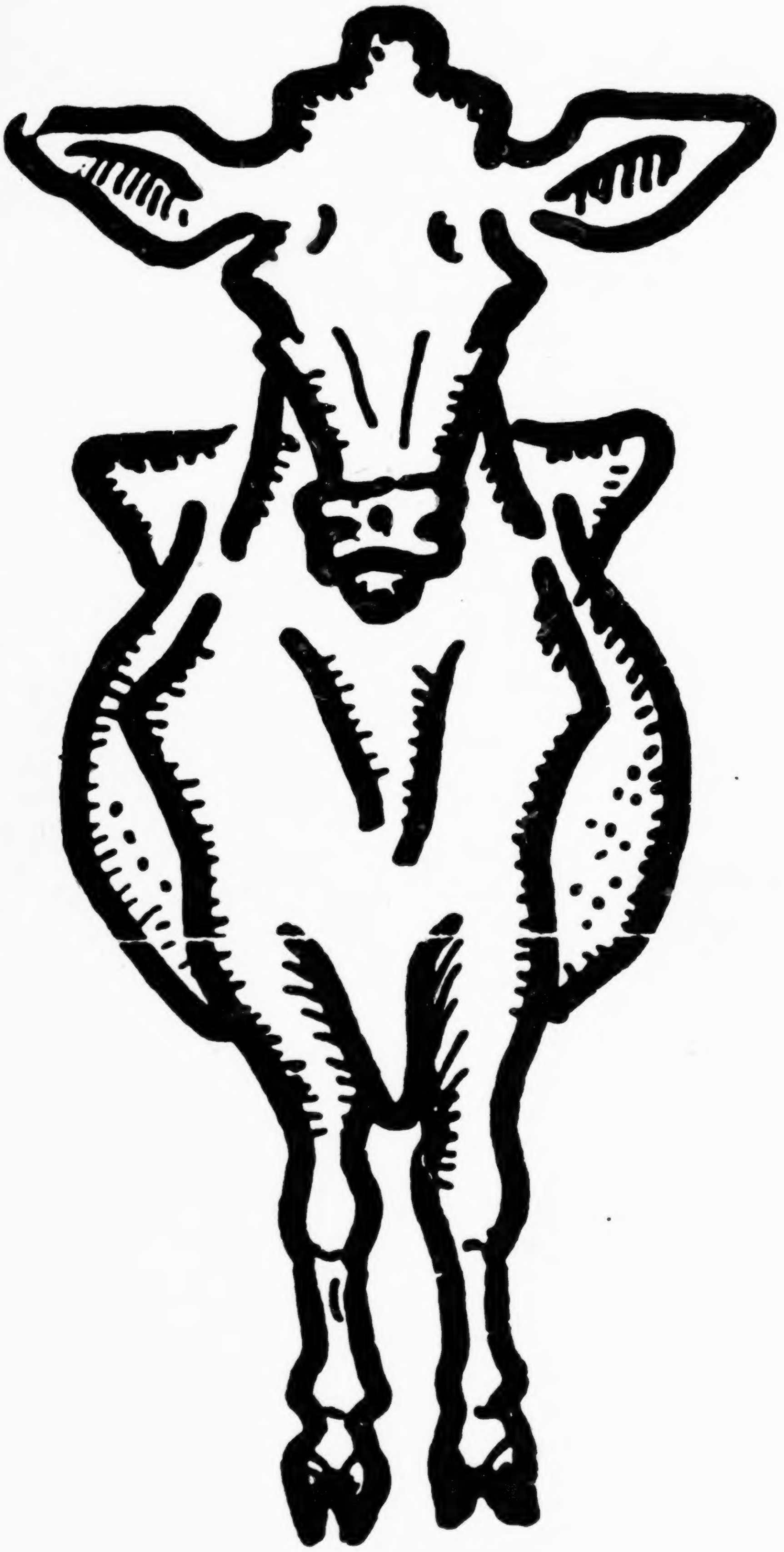
Common Faults--Front View



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BEEF BREEDS

BREED	COLOR	ORIGIN	HEAD CHARACTERISITCS
Angus	Black	Scotland	Polled
Red Angus	Red	British Isles	Polled
Galloway	Black	Scotland	Polled
Hereford	Red with White markings	England	Horned
Polled Hereford	Red with White markings	United States Iowa	Polled
Shorthorns	Red, white or any combination	England	Horned
Polled Shorthorn	Red, white or any combination	United States	Polled
Charolais	White to cream	France .	Horned
Scotch Highland	Black, brindle, red light red, yellow, dun, and silver	Scotland	Long widespread horns
Brahman	Gray or red	India	Drooping ears, a long face

Beef Breeds - continued

BREED	COLOR	ORIGIN	HEAD CHARACTERISTICS
Santa Gertrudis	Red or cherry red	United States Brahman & Shorthorn	Horned
Brangus	Black	United States 3/8 Brahman & 5/8 Angus	Polled
Beefmaster	No specific color red dominant	United States 1/2 Brahman, 1/4 Shorthorn, 1/4 Hereford	Horned
Charbray	Born light tan, bleaches to cream white	United States Charlais & Brahman	Horned
Braford	Red or red with white face, brindle or dark brown	United States Brahman & Herford	Either

Lesson 4. Selecting Sheep 2 days and 1 day field trip

OBJECTIVES:

1. To recognize ideal mutton type.
2. To be able to identify principal parts of sheep so as to discuss them intelligently.
3. To recognize principal breeds and to distinguish them based on usefulness for wool and mutton.

REFERENCES:

Breed Association pictures and literature

Livestock and Poultry Production, pages 440 - 446

Animal Science, pages 620 - 635; also Chapter XVIII.

Handouts:		Page
	"Parts of a Sheep"	51
	"Sheep Breeds Classified by Wool Type"	64

Transparencies:		Page
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	"Parts of a Sheep"	52
	"Wholesale Cuts of a Lamb Carcass"	53
	"Major Parts of a Sheep"	54
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	"Common Faults--Side View"	58
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	"Common Faults--Front View"	60
	"A Procedure for Examining Sheep"	61
	"Catching and Holding Sheep"	62
	"Determining Age of Sheep by Their Teeth"	63

MOTIVATION:

Can you tell a Hampshire sheep from a Cheviot? Have you ever seen a sheep with very erect ears that almost looks like a deer? (Show Cheviot.) Why might a sheep breeder be proud of a ewe that had lots of wrinkles in its skin? Judging sheep is different from other classes of livestock. It will be fun to learn about differences in sheep.

OUTLINE:

A. Parts of a Sheep

B. Wholesale Cuts of a Sheep Carcass

C. Major Parts of a Desirable Sheep

D. Ideal Conformation of Sheep
   1. Side View
      a. large, early-maturing
      b. balanced and symmetrical
      c. great depth of body
      d. short coupled
      e. low-set
      f. strong, level back
      g. level rump
      h. trim underline
      i. blocky
      j. short, thick neck
      k. straight, true, squarely set legs
      l. strong pasterns
      m. ample bone
      n. style, pleasing and alert appearance
      o. breed type
      p. smooth bodied
   2. Rear View
      a. uniformly wide from front to rear
      b. wide over back and loin
      c. trim in the middle
      d. level rump
      e. deep, plump leg
      f. legs set wide apart
   3. Front View
      a. short, broad head
      b. femininity and masculinity
      c. wide, rounding, and moderately prominent brisket
      d. wide chest
      e. correctly set front legs

E. Common Faults in Conformation
   1. Side View
      a. undersized
      b. lacking in balance and symmetry
      c. shallow bodied
      d. long bodied
      e. leggy; upstanding
      f. weak back

    g. sloping rump
    h. high in flanks
    i. angular
    j. long necked
    k. crooked legs, weak pasterns
    l. coarse boned
    m. lacking in style
    n. lacking breed type
    o. wrinkles along neck
2. Rear View
    a. narrow bodied
    b. lacking width over top
    c. paunchy
    d. sloping in rump
    e. lacking width, depth, and fullness of quarters
    f. cow hocked
3. Front View
    a. plain head
    b. lacking femininity and masculinity
    c. too heavy and wasty in brisket
    d. a narrow chest
    e. crooked front legs, or twisted bones or feet

F. Important Breed Characteristics

PROCEDURES:

1. Discuss importance of knowing the names of parts so we can talk about good and bad parts of animals and all be describing the same thing. Show the transparency and let students label as many as they can correctly. Give students an unlabeled handout sheet. Then show the labeled transparency and have students finish labeling their handout. Tell them how many of the parts you expect them to learn and how soon.

2. Show the transparency "Wholesale Cuts of a Lamb Carcass." Discuss the relative value of the various parts. (Current prices from your local butcher would add interest.) Why is it important for us as livestock producers and judges to know that lamb chops are more valuable than shoulder meat and where the various cuts are located on a live animal?

3. Show the transparency "Major Parts of a Sheep." To what extent are the expensive cuts of meat reflected in these desirable characteristics?

4. Show the "Side View--Ideal Type." Follow D.1 in Outline to point out desired characteristics.

5. Show "Rear View--Ideal type." Follow D.2 in Outline to point out desired characteristics.

6. Show "Front View--Ideal Type." Follow D.3 in Outline to point out desired characteristics.

7. Show "Common Faults--Side View." Follow E.1 in Outline to describe and point out the faults. Show ideal side view again to emphasize correct type.

8. Show "Common Faults--Rear View." Follow E.2 in Outline to describe and point out the faults. Show ideal rear view again to emphasize correct type.

9. Show "Common Faults--Front View." Follow E.3 in Outline to describe and point out the faults. Show ideal front view again to emphasize correct type.

10. Again show the transparency "Major Parts of a Sheep" and emphasize that it is really the big things that count most. Refer to the transparency on wholesale cuts again and be sure students feel confident they understand the essential make-up of an ideal animal. Give them the handout on Major Parts of a Sheep.

11. Discuss judging a class of sheep. Show the transparency "A Procedure for Examining Sheep." Why does one have to "see with his hands" when judging sheep? Show the transparency on "Catching and Holding Sheep."

12. Show the transparency "Determining Age of Sheep by Their Teeth."

13. Discuss "overshot" and "undershot" jaws. Why is it important for teeth to meet the pad correctly?

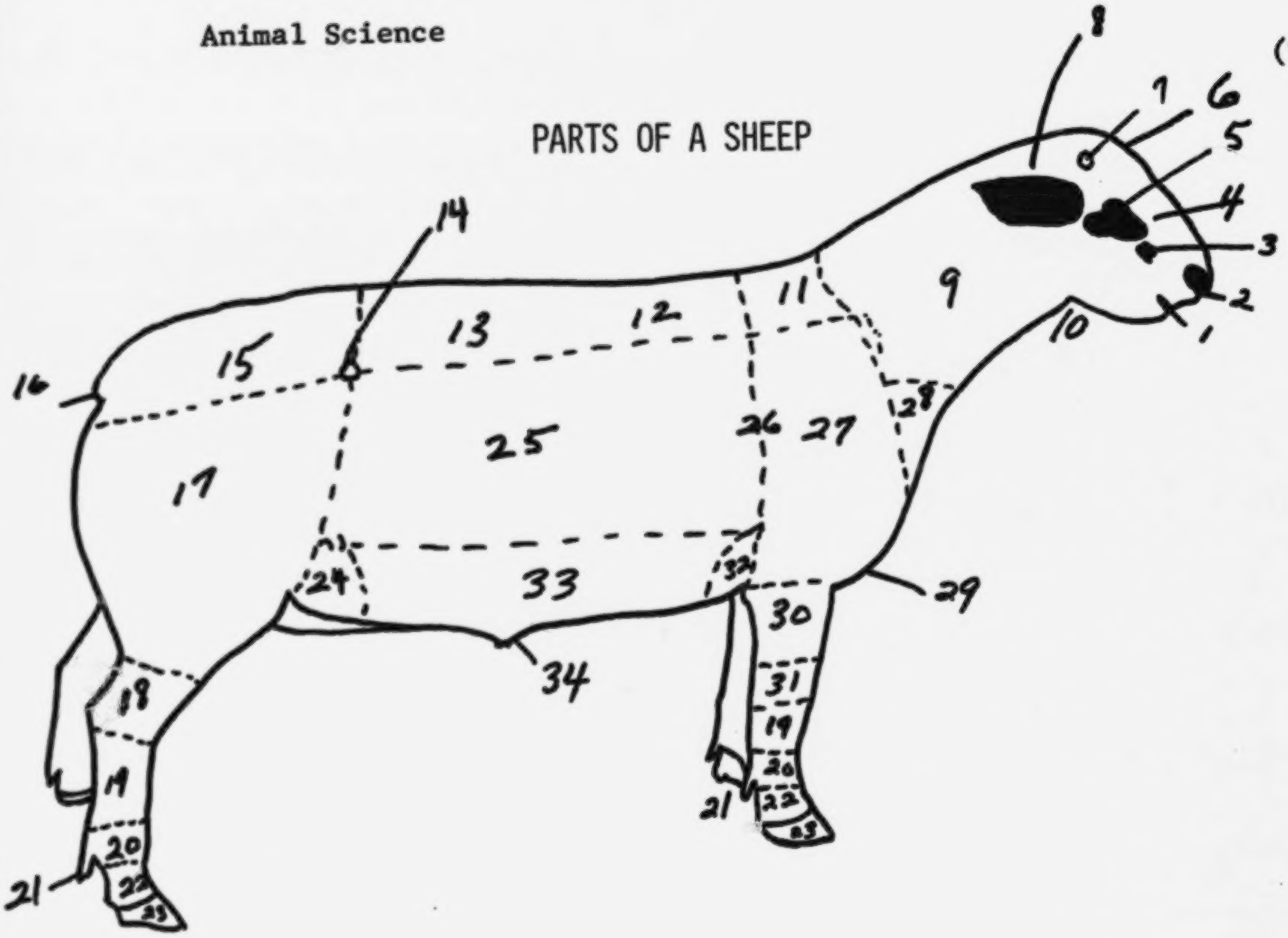
14. Discuss soundness of udders.

15. Show transparency of sheep breeds classified according to wool type. Briefly discuss wool differences and relationships between mutton and wool breeds. Hand out "Breeds of Sheep Classified by Wool Type."

16. Show pictures of some common sheep breeds.

SUMMARY:

PARTS OF A SHEEP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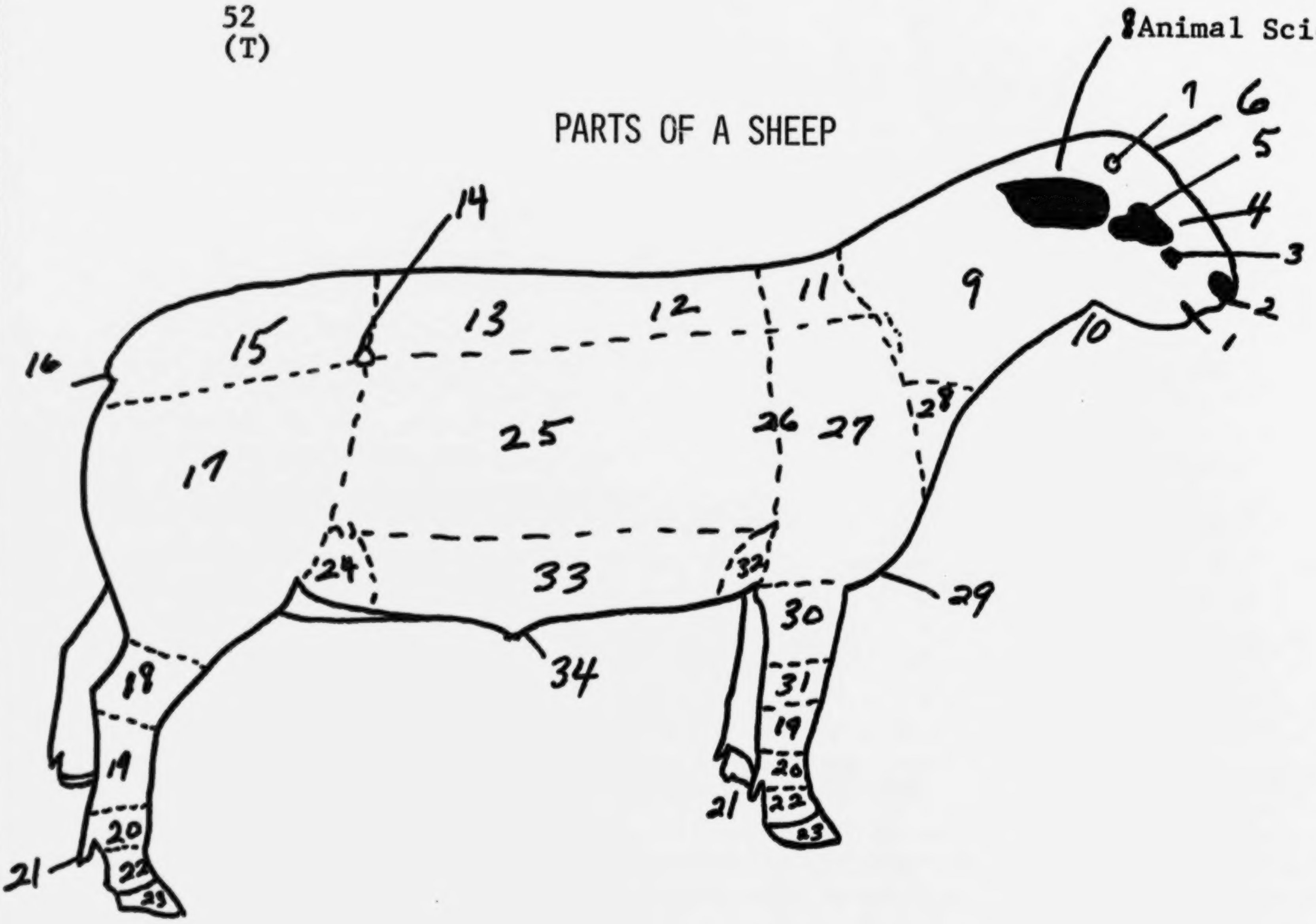
PARTS OF A SHEEP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1 MOUTH
2 NOSTRIL
3 SUBORBITAL GLAND
4 FACE
5 EYE
6 FOREHEAD
7 HORN PIT
8 EAR
9 NECK
10 THROAT
11 TOP OF SHOULDER
12 BACK

13 LOIN
14 HIP
15 RUMP
16 DOCK
17 LEG OF LAMB
18 HOCK
19 SHANK
20 PASTERN JOINT OR ANKLE
21 DEW CLAW
22 PASTERN
23 TOE

24 HIND FLANK
25 RIBS
26 HEART GIRTH
27 SHOULDER
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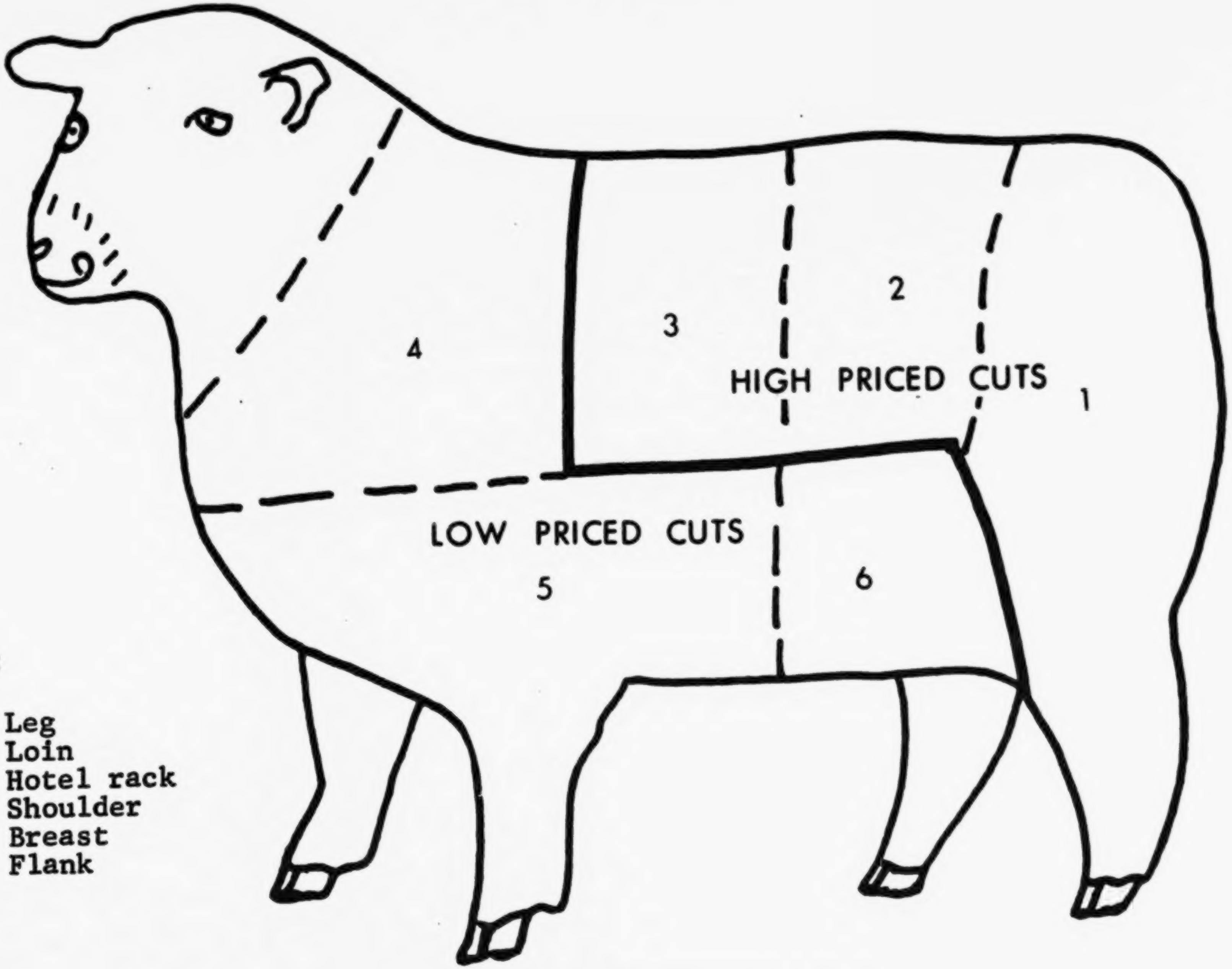
29 BRISKET
30 FOREARM
31 KNEE
32 FOREFLANK
33 BELLY
34 PENIS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HIGH PRICED CUTS
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LOW PRICED CUTS
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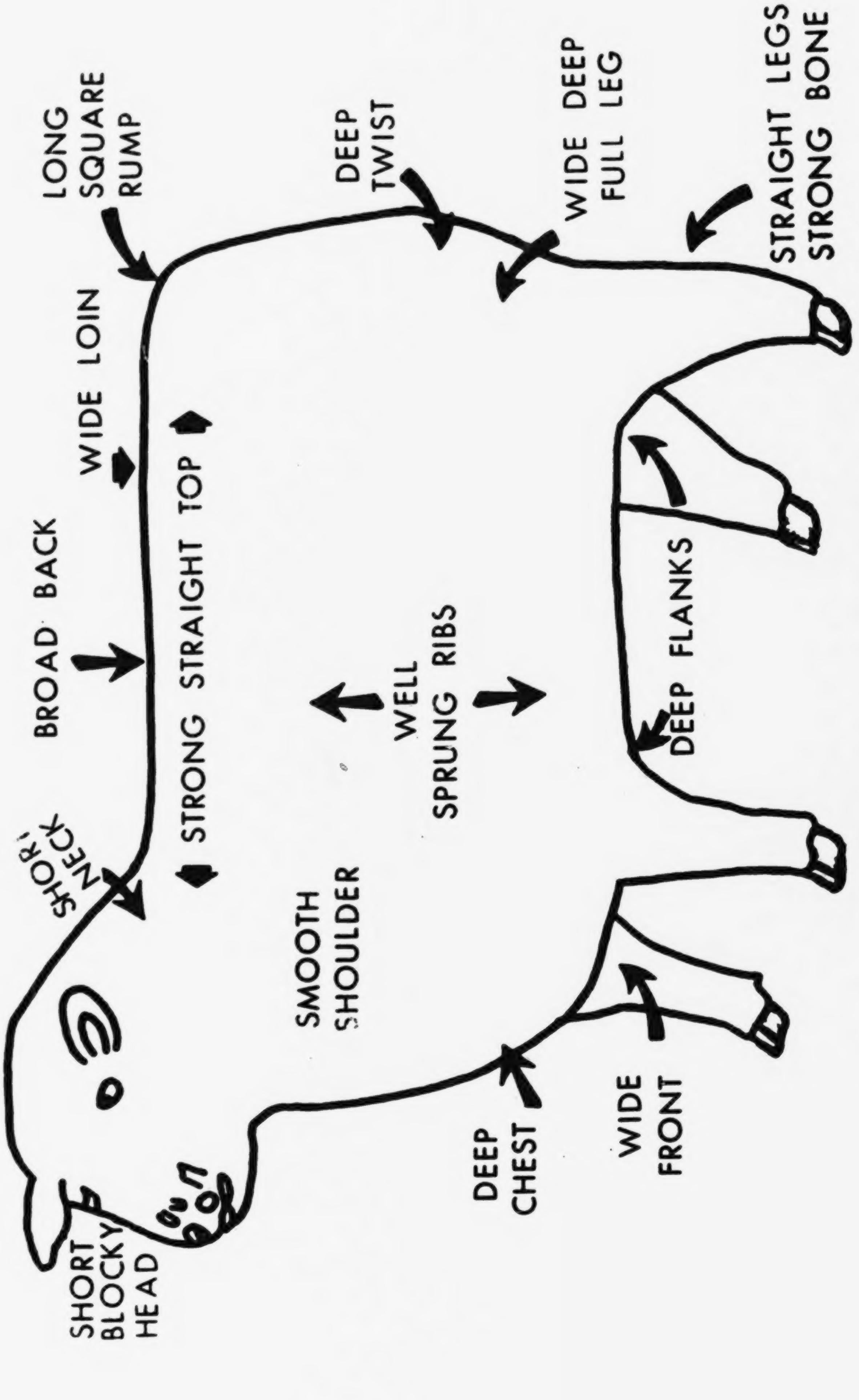
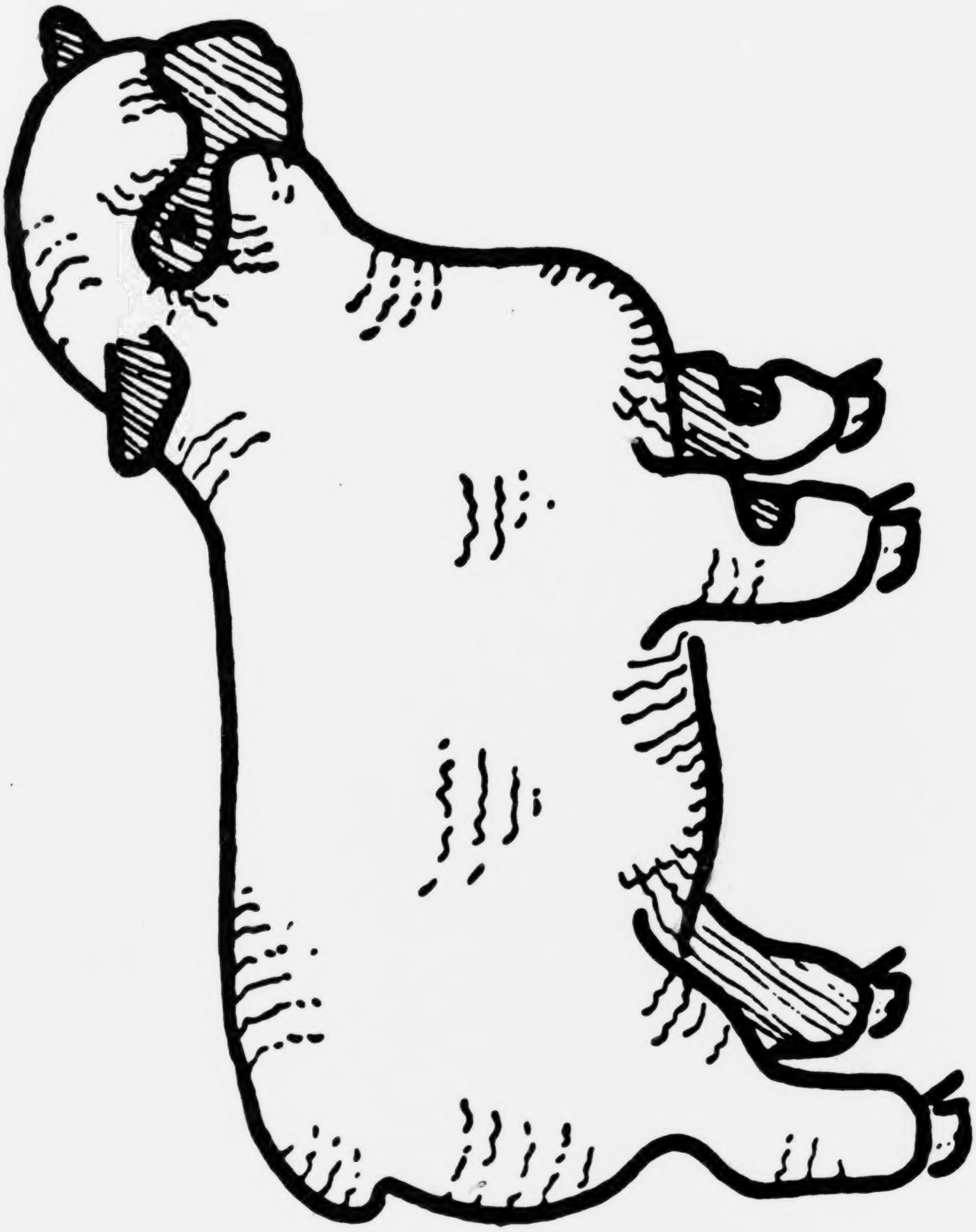
Key:

1. Leg
2. Loin
3. Hotel rack
4. Shoulder
5. Breast
6. Flank

Wholesale Cuts of a Lamb Carcass.


SHORT BLOCKY HEAD
SHORT NECK
BROAD BACK
WIDE LOIN
LONG SQUARE RUMP
DEEP TWIST
WIDE DEEP FULL LEG
STRAIGHT LEGS STRONG BONE
STRONG STRAIGHT TOP
SMOOTH SHOULDER
WELL SPRUNG RIBS
DEEP CHEST
WIDE FRONT
DEEP FLANKS

Major Parts of a Sheep



Ideal Type--Side View

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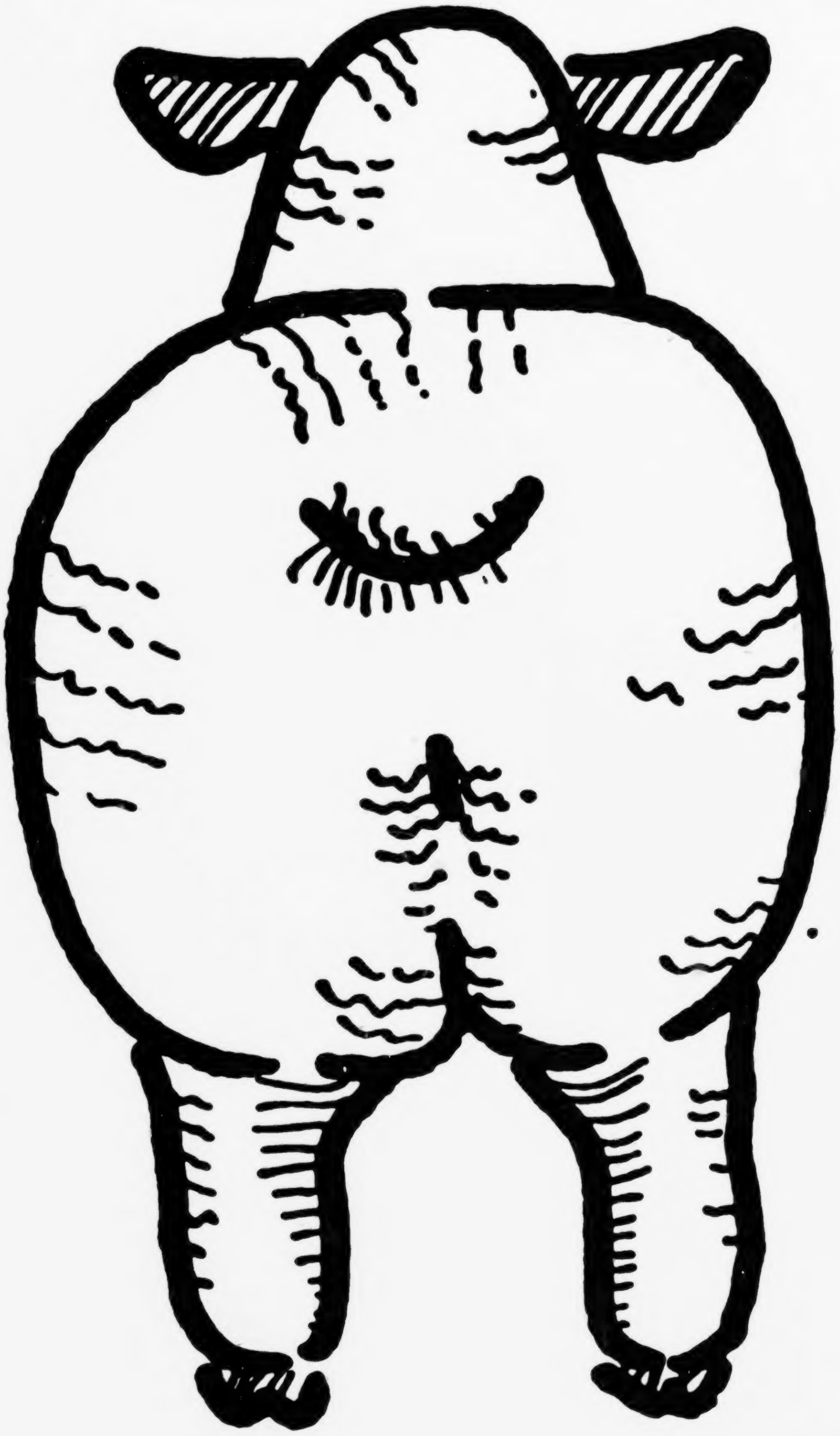
Ideal Type--Rear View



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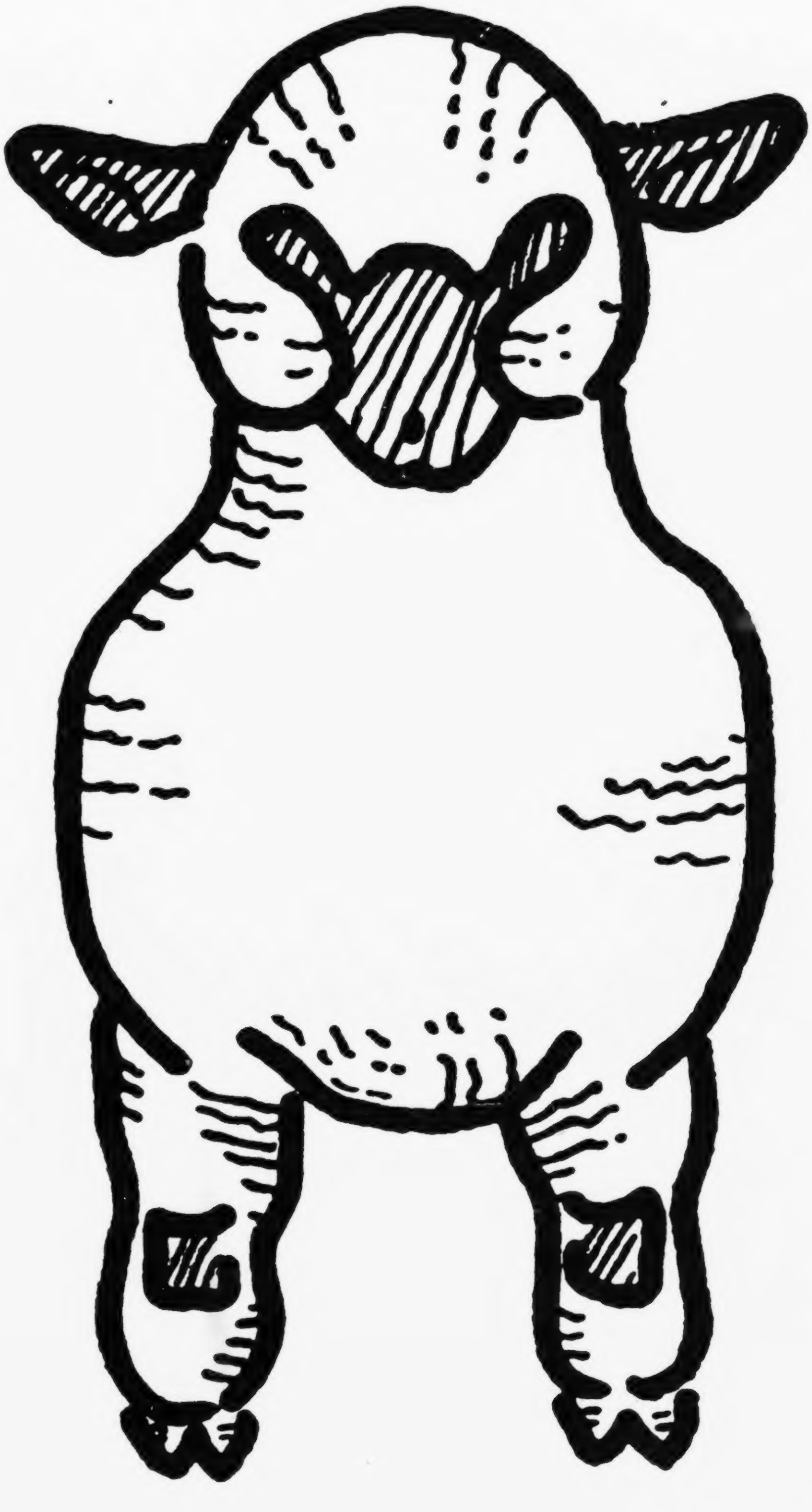
Ideal Type--Front View



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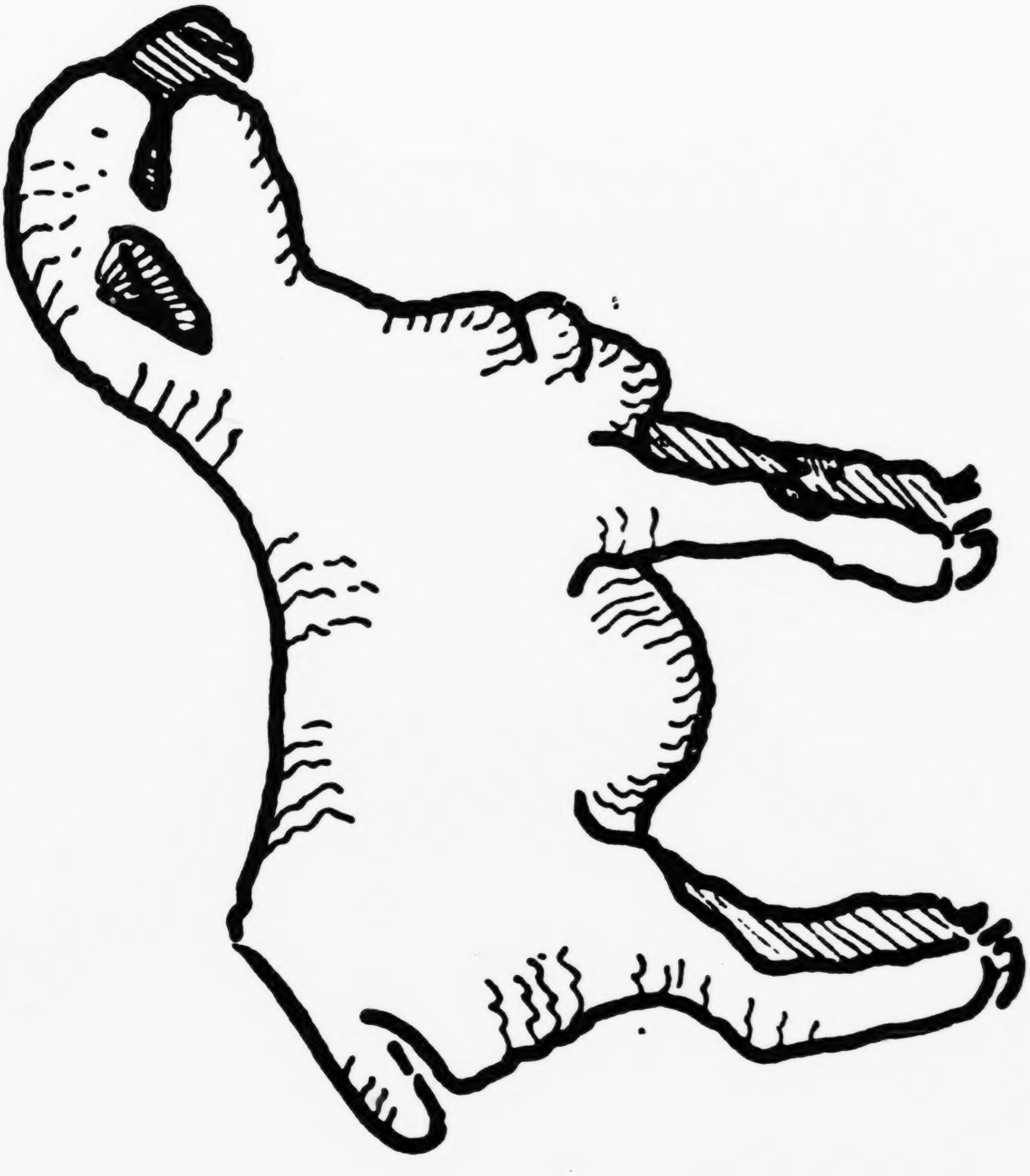

Common Faults--Side View

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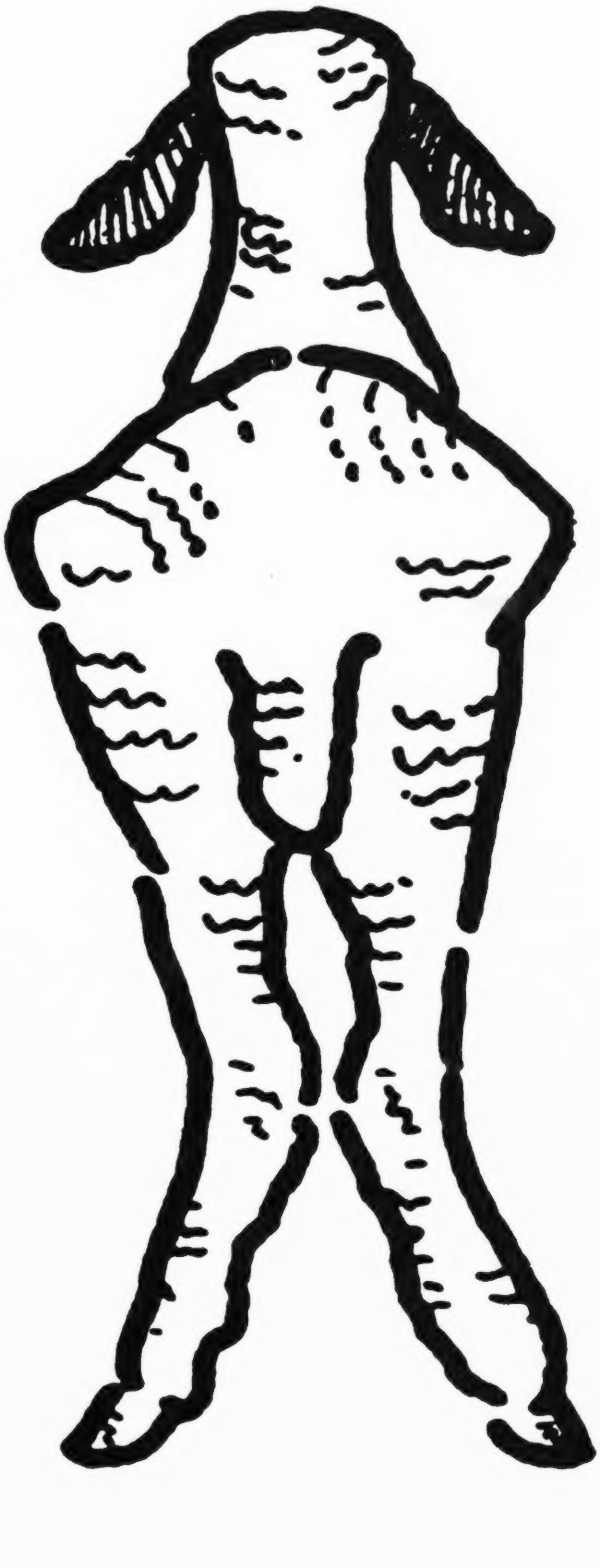
Common Faults--Rear View



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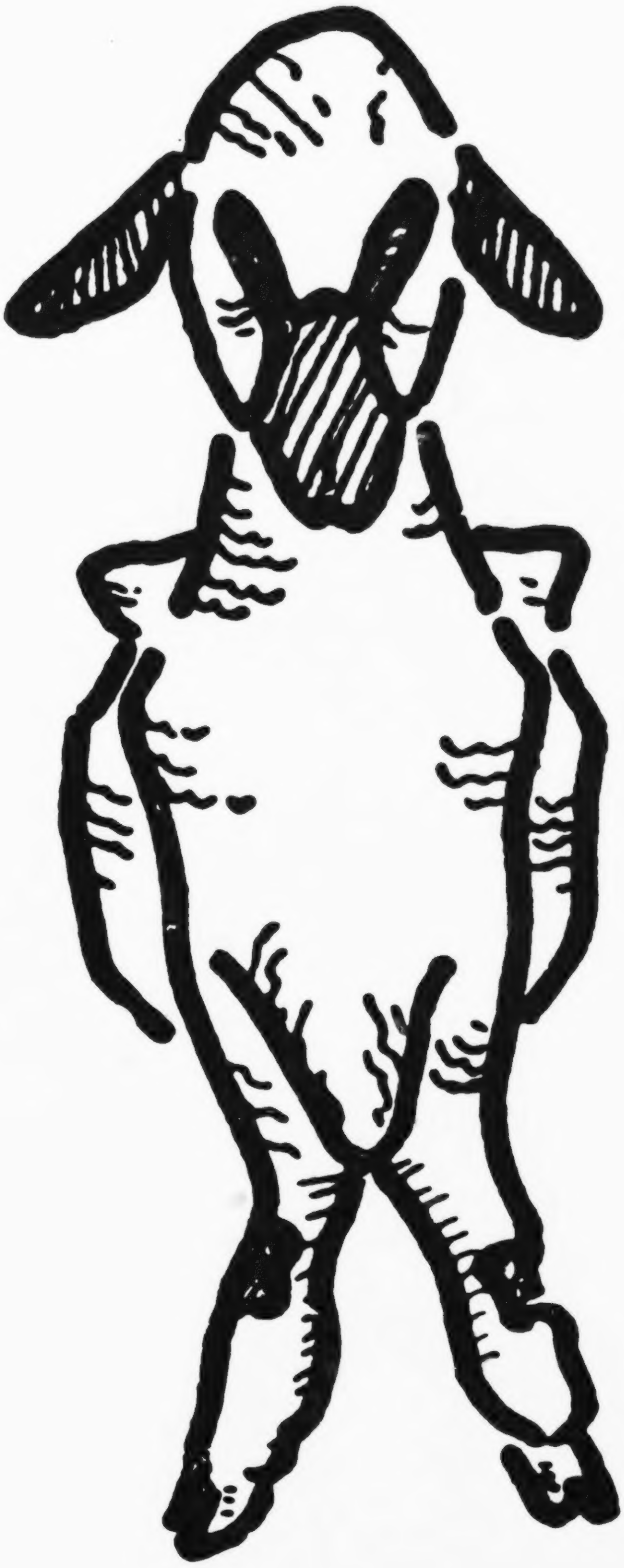
Common Faults--Front View



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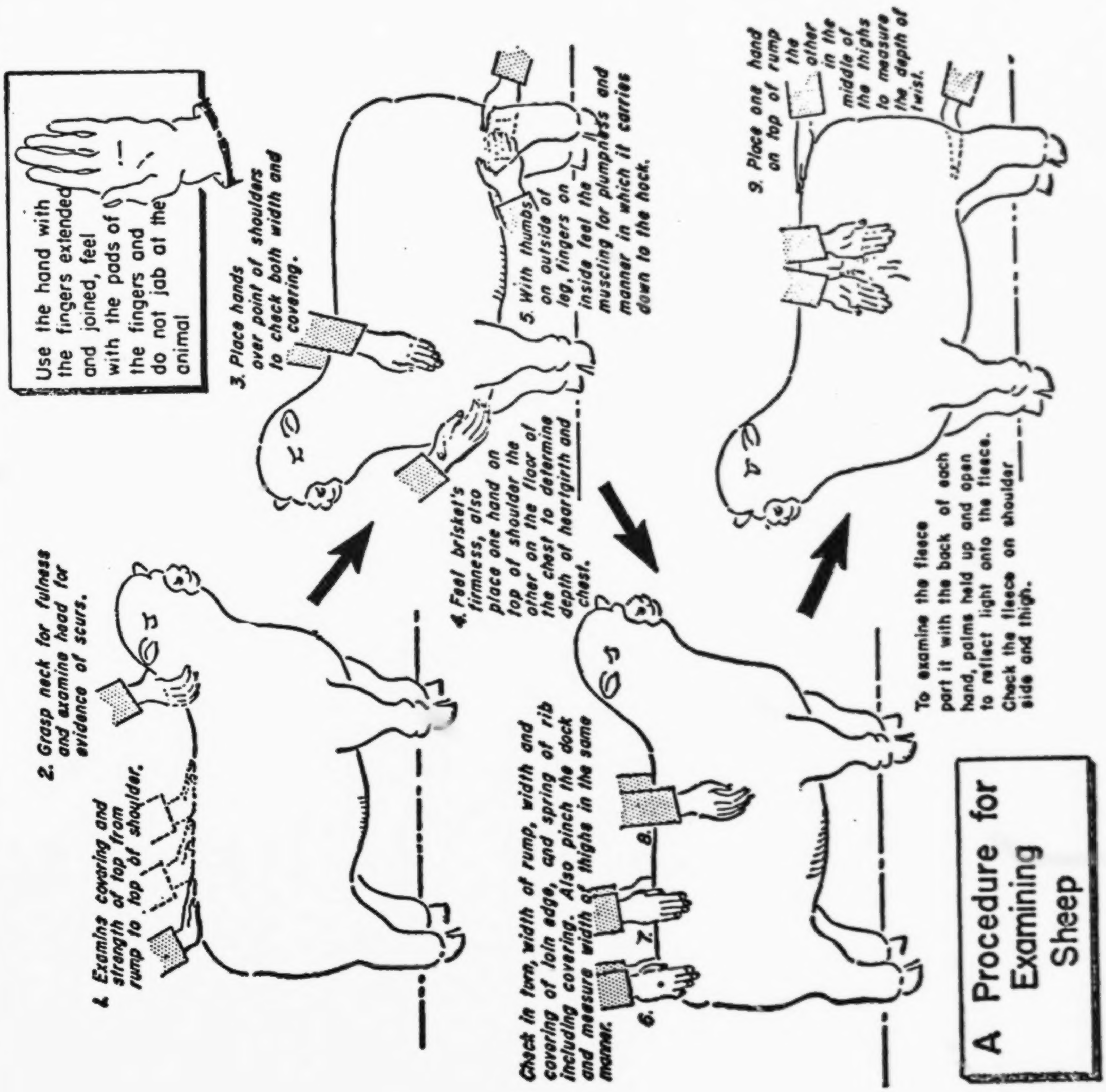

A Procedure for Examining Sheep

Use the hand with the fingers extended and joined, feel with the pads of the fingers and do not jab at the animal

1. Examine covering and strength of top from rump to top of shoulder.

2. Grasp neck for fulness and examine head for evidence of scurs.

3. Place hands over point of shoulders to check both width and covering.

4. Feel brisket's firmness, also place one hand on top of shoulder the other on the floor of the chest to determine depth of heartgirth and chest.

5. With thumbs on outside of leg, fingers on inside feel the muscling for plumpness and manner in which it carries down to the hock.

Check in turn, width of rump, width and covering of loin edge, and spring of rib including covering. Also pinch the dock and measure width of thighs in the same manner.

9. Place one hand on top of rump the other in the middle of the thighs to measure the depth of twist.

To examine the fleece part it with the back of each hand, palms held up and open to reflect light onto the fleece. Check the fleece on shoulder side and thigh.

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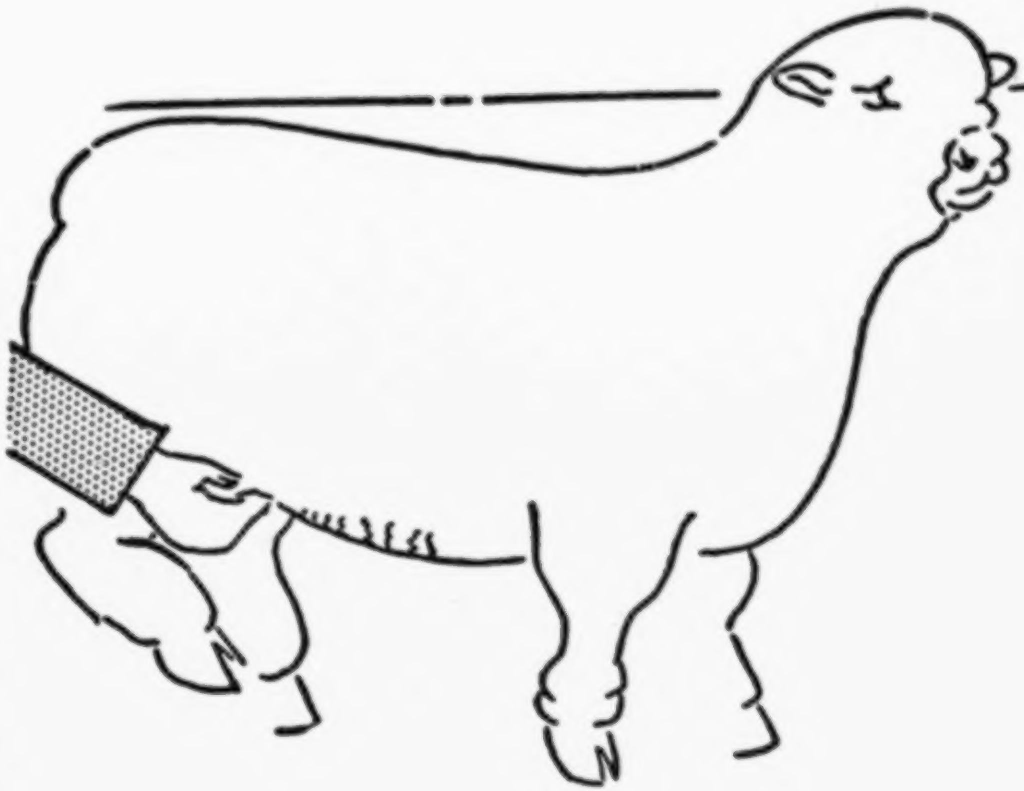
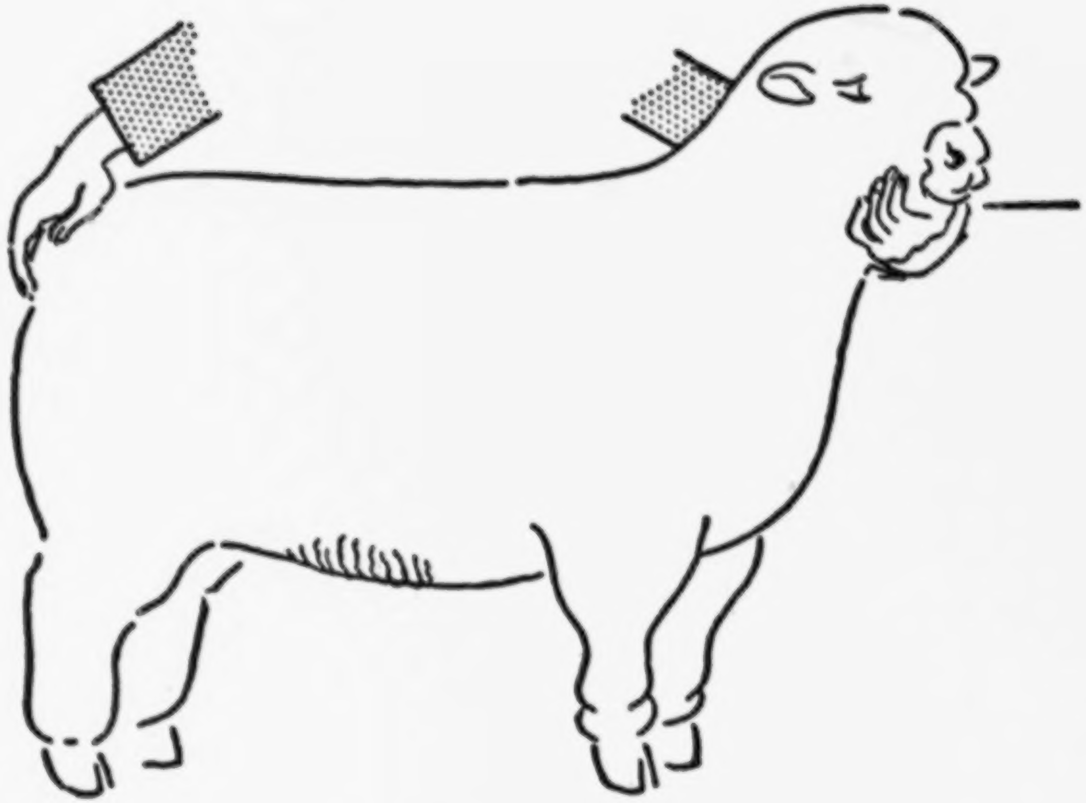
CATCHING

- *Confine the animals in a small area*
- *Move up quietly on the desired animal after working it into a position near you*
- *With a swift sure movement grasp well up into the right rear flank with the right hand*
- *Holding firmly with the right hand, quickly grasp under the lower jaw with the left*



HOLDING

- *With the left hand firmly grasp a fold of flesh under the lower jaw*
- *Place the right hand securely over the dock, the right hand in this position can be useful in moving the animal*
- *As the animal quiets down the right hand may be removed*



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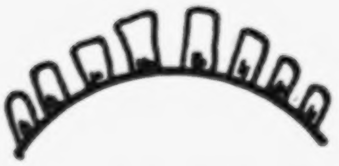
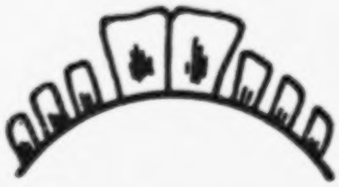
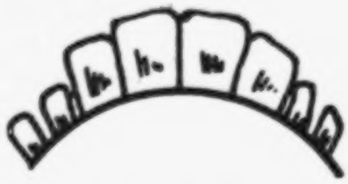
Determining the Age of Sheep By Their Teeth



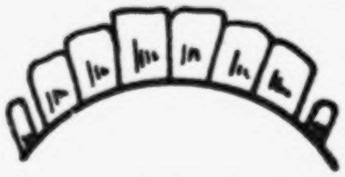
1. Lamb's mouth with 8 incisors, these temporary teeth are called milk teeth



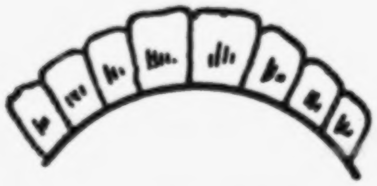
2. Yearling mouth with 1 pair of permanent incisors



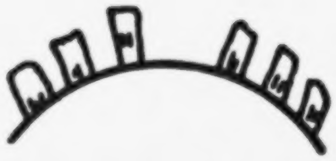
3. 2-yr. old mouth with 2 pair of permanent incisors



4. 3-yr. old mouth with 3 pairs of permanent incisors



5. 4-yr. old mouth with 4 pairs of permanent incisors



6. Broken mouth condition which may begin to occur about 6 yrs. of age, a sheep that has lost all incisors is called a gummer

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SHEEP BREEDS CLASSIFIED BY WOOL TYPE

BREED	COLOR MARKINGS	HORNS	WEIGHT	ORIGIN
	FINE WOOL			
Merino	White, with white lips and hoofs	R-1½turns E-none	R-175 E-125	Spain
Rambouillet	White, with white lips and hoofs	R-1½turns E-none	R-225 E-155	France
	MEDIUM WOOL			
Cheviot	White, no wool on face & legs	R-none E-none	R-175 E-125	Scotland
Dorset	White, with white lips nostrils and hoofs	R-1/2 turn E-3/4 turn	R-235 E-165	England
Hampshire	Very dark brown to black	R-none E-none	R-275 E-190	England
Oxford	Medium brown or dark gray	R-none E-none	R-300 E-200	England
Shropshire	Dark rich brown to dull black	R-none	R-225 E-160	England
Southdown	Mouse brown to gray brown with dark lips	R-none E-none	R-185 E-140	England
Suffolk	Jet black, no wool on face or ears but O.K. on forehead	R-none E-none	R-250 E-170	England

Sheep Breeds Classified by Wool Type - continued

BREED	COLOR MARKINGS	HORNS	WEIGHT	ORIGIN
	LONG WOOL			
Cotswold	White, wool hangs in curls, tuft of wool hangs from the forehand over the eyes	R-none E-none	R-300 E-225	England
Leicester	White, clean face and legs	R-none E-none	R-240 E-200	England
Lincoln	White, clean face with dark nostrils, lips, and feet	R-none E-none	R-300 E-235	England
Romney	White, hoofs, nostrils and lips are dark colored	R-none E-none	R-225 E-185	England
	CROSSBRED WOOL			
Columbia	White, or spotted nostrils, hoofs and ears	R-none E-none	R-260 E-175	United States
Corriedale	White, with dark nostrils and hoofs, black and blue spots on ears O.K.	R-none E-none	R-200 E-160	New Zealand & Australia
	FUR			
Karakul	Brown or black	R-horns E-none	R-200 E-150	Persia

Lesson 5. Selecting Hogs 2 days and 1 day field trip

OBJECTIVES:

1. To recognize correct type in hogs.
2. To be able to identify principal parts of hogs so as to discuss them intelligently.
3. To recognize principal breeds of hogs.

REFERENCES:

Breed association literature

Livestock and Poultry Production, pages 72 - 81; 51 - 72

Animal Science, pages 815 - 824, also Chapter XXVIII.

"Breed Study and Identification Kit"

		Page
Handout:	"Parts of a Hog" (unlabeled)	71
	"Hog Breed Characteristics"	82
Transparencies:	"Parts of a Hog" (unlabeled)	71
	"Parts of a Hog"	72
	"Wholesale Cuts of a Pork Carcass"	73
	"Major Parts of a Hog"	74
	"Side View--Ideal Type"	75
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	"Front View--Ideal Type"	77
	"Common Faults--Side View"	78
	"Common Faults--Rear View"	79
	"Common Faults--Front View"	80
	"A Method for Examining Swine"	81

MOTIVATION:

Hogs have been called mortgage lifters for a long time in Missouri. What's a mortgage lifter? Much has happened to the shape (type) of hogs over the years. What type do we want today? Show pictures of old and new type.

OUTLINE:

A. Parts of a Hog

B. Wholesale Cuts of a Hog

C. Major Parts of a Desirable Hog

D. Ideal Conformation of Hog
- 1. Side View
  - a. large, early maturing
  - b. balanced and symmetrical
  - c. adequate length
  - d. adequate depth
  - e. moderate, evenly arched back
  - f. high tail setting
  - g. deep in flanks
  - h. legs straight and squarely set, moderate length of leg
  - i. strong pasterns
  - j. trim underline and jowl
  - k. smooth shoulders; free from wrinkles
  - l. style
  - m. twelve or more well-developed teats
- 2. Rear View
  - a. uniform width from front to rear
  - b. wide and full over loin
  - c. plump, full, trim, and firm ham; meated well down to hocks
  - d. legs set well apart
- 3. Front View
  - a. shapely and trim head
  - b. true to breed characteristics
  - c. femininity and masculinity
  - d. correctly set front legs

E. Common Faults in Conformation
- 1. Side View
  - a. undersized
  - b. lacking in balance
  - c. short side
  - d. shallow body
  - e. steep rump
  - f. low tail setting
  - g. leggy, weak pasterns
  - h. wrinkles
  - i. coarseness
  - j. lacking breed characteristics
  - k. blind teats
- 2. Rear View
  - a. "fish-backed"
  - b. rough shoulders
  - c. low back of shoulders
  - d. narrow and pinched over loin

      e. light ham; long shank
      f. crooked hind legs
   3. Front View
      a. a plain head
      b. lacking femininity and masculinity
      c. crooked front legs

F. Judging a Class of Hogs (Procedures)

G. Important Breed Characteristics

PROCEDURES:

1. Discuss importance of knowing the names of parts so we can talk about good and bad parts of animals and all be describing the same thing. Show the transparency and let students label as many as they can correctly. Give students an unlabeled handout sheet. Then show the labeled transparency and have students finish labeling their handout. Tell them how many of the parts you expect them to learn and how soon.

2. Show the transparency "Wholesale Cuts of a Hog Carcass." Discuss the relative value of the various parts. (Current prices from your local butcher would add interest.) Why is it important for us as livestock producers and judges to know that pork chops are more valuable than jowl and where the various cuts are located on a live animal?

3. Show the transparency "Major Parts of a Hog." To what extent are the expensive cuts of meat reflected in these desirable characteristics?

4. Show the "Side View--Ideal Type." Follow D.1 in Outline to point out desired characteristics.

5. Show "Rear View--Ideal Type." Follow D.2 in Outline to point out desired characteristics.

6. Show "Front View--Ideal Type." Follow D.3 in Outline to point out desired characteristics.

7. Show "Common Faults--Side View." Follow E.1 in Outline to describe and point out the faults. Show ideal side view again to emphasize correct type.

8. Show "Common Faults--Rear View." Follow E.2 in Outline to describe and point out the faults. Show ideal rear view again to emphasize correct type.

9. Show "Common Faults--Front View." Follow E.3 in Outline to describe and point out the faults. Show ideal front view again to emphasize correct type.

10. Again show the transparency "Major Parts of a Hog" and emphasize that it is really the big things that count most. Refer to the transparency on wholesale cuts again and be sure students feel confident they understand the essential make-up of an ideal animal. Give them the handout on "Major Parts of a Hog."

11. Discuss the procedure for judging a class of hogs. Show the transparency, "A Method for Examining Swine."

12. Show pictures of some common hog breeds. After a brief discussion of which is best, distribute the sheet on breed characteristics. Tell students how much of this you expect them to learn.

SUMMARY:

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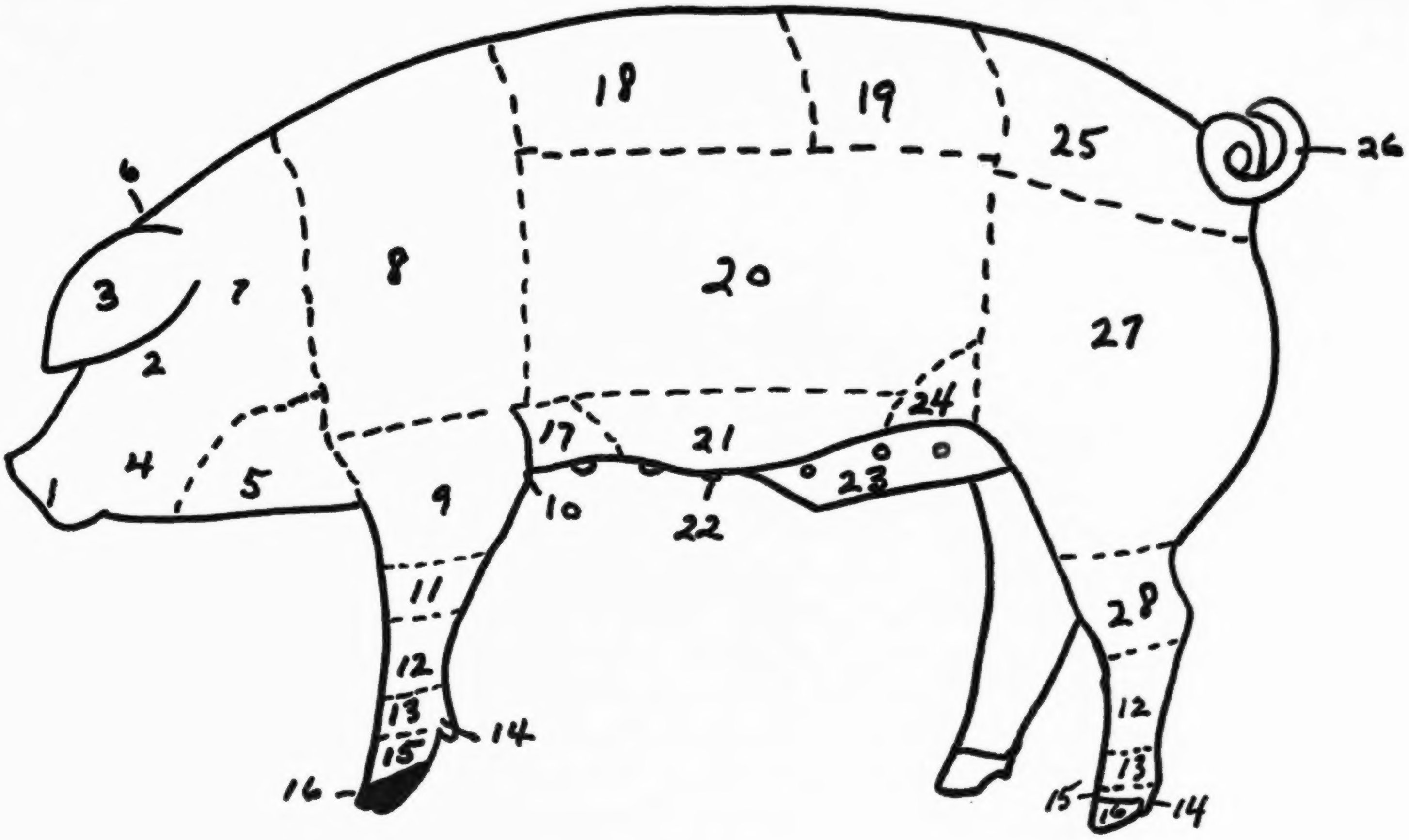
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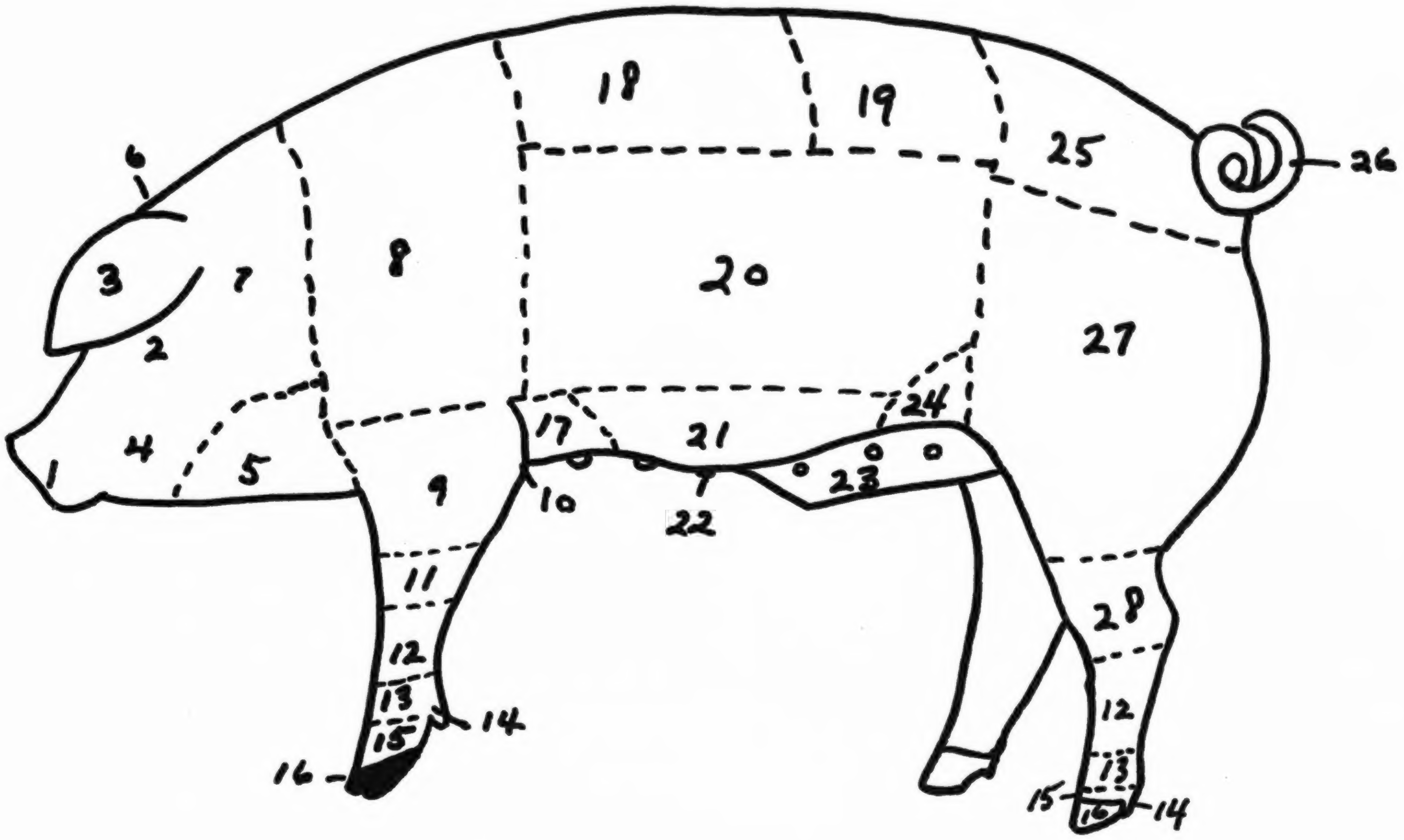
PARTS OF A HOG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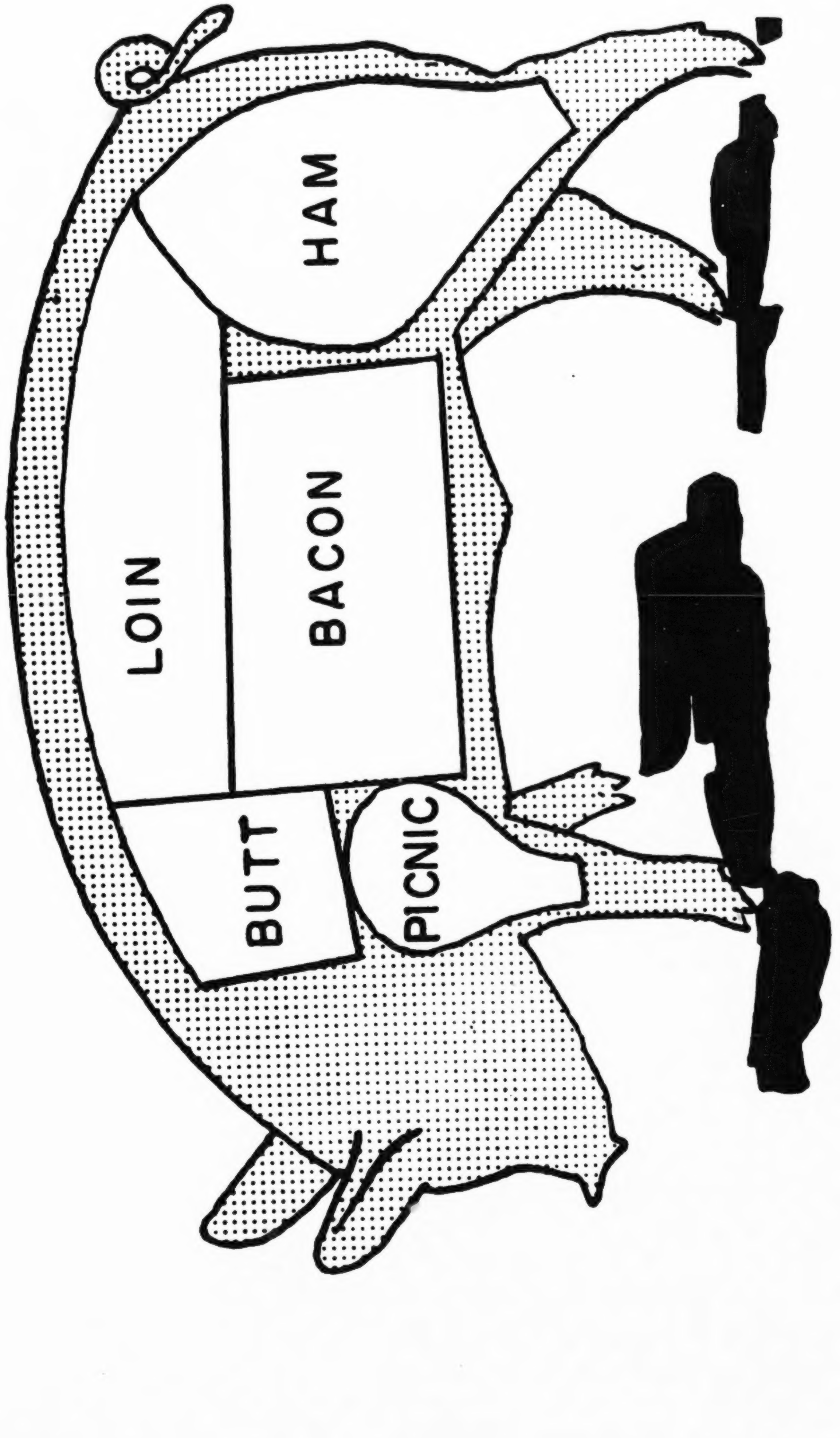
1 SNOUT
2 EYE
3 EAR
4 CHEEK
5 JOWL
6 POLL
7 NECK
8 SHOULDER
9 FORELEG
10 ELBOW

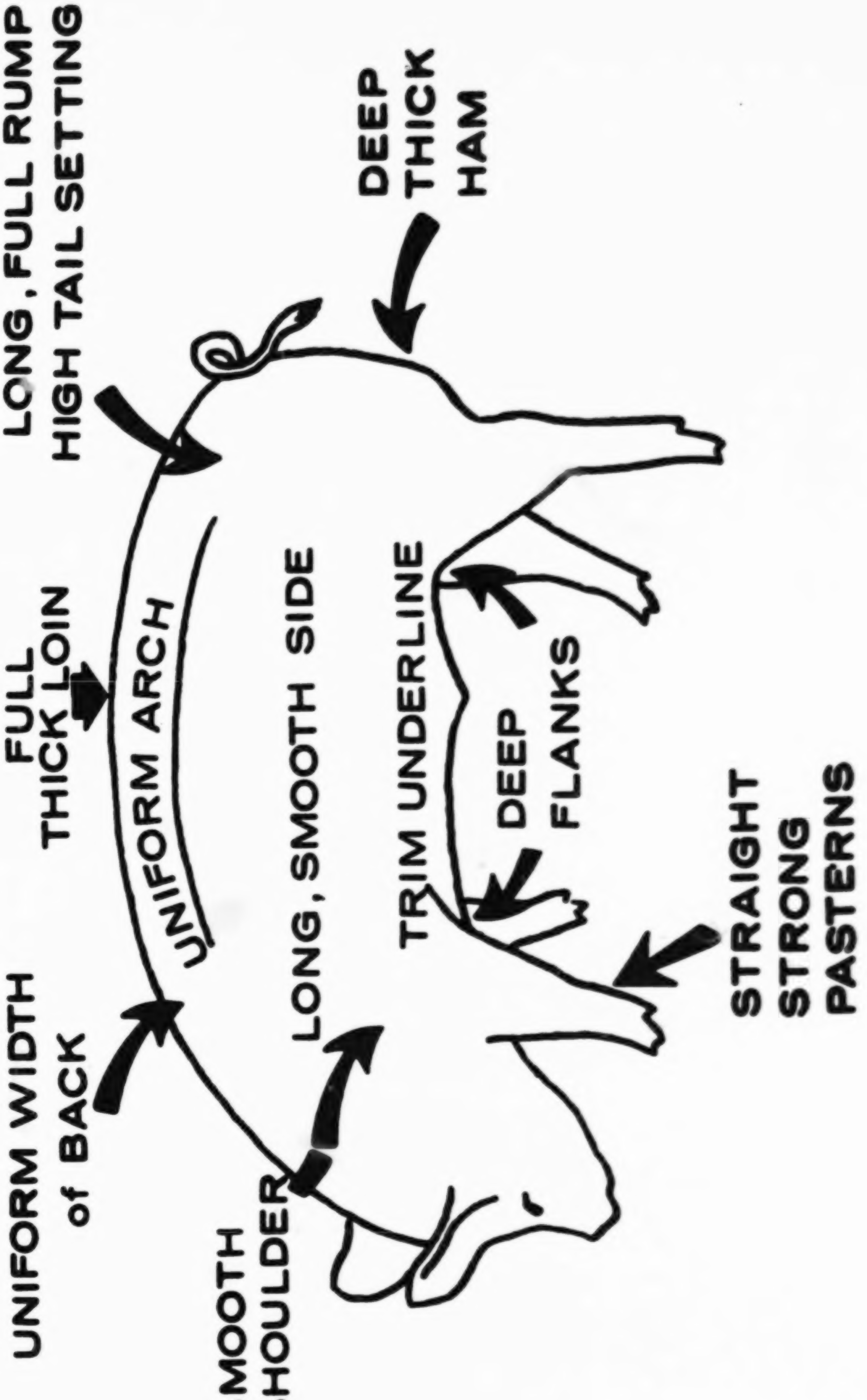
11 KNEE
12 SHANK
13 ANKLE
14 DEW CLAW
15 PASTERN
16 TOE
17 FOREFLANK
18 BACK
19 LOIN
20 SIDE

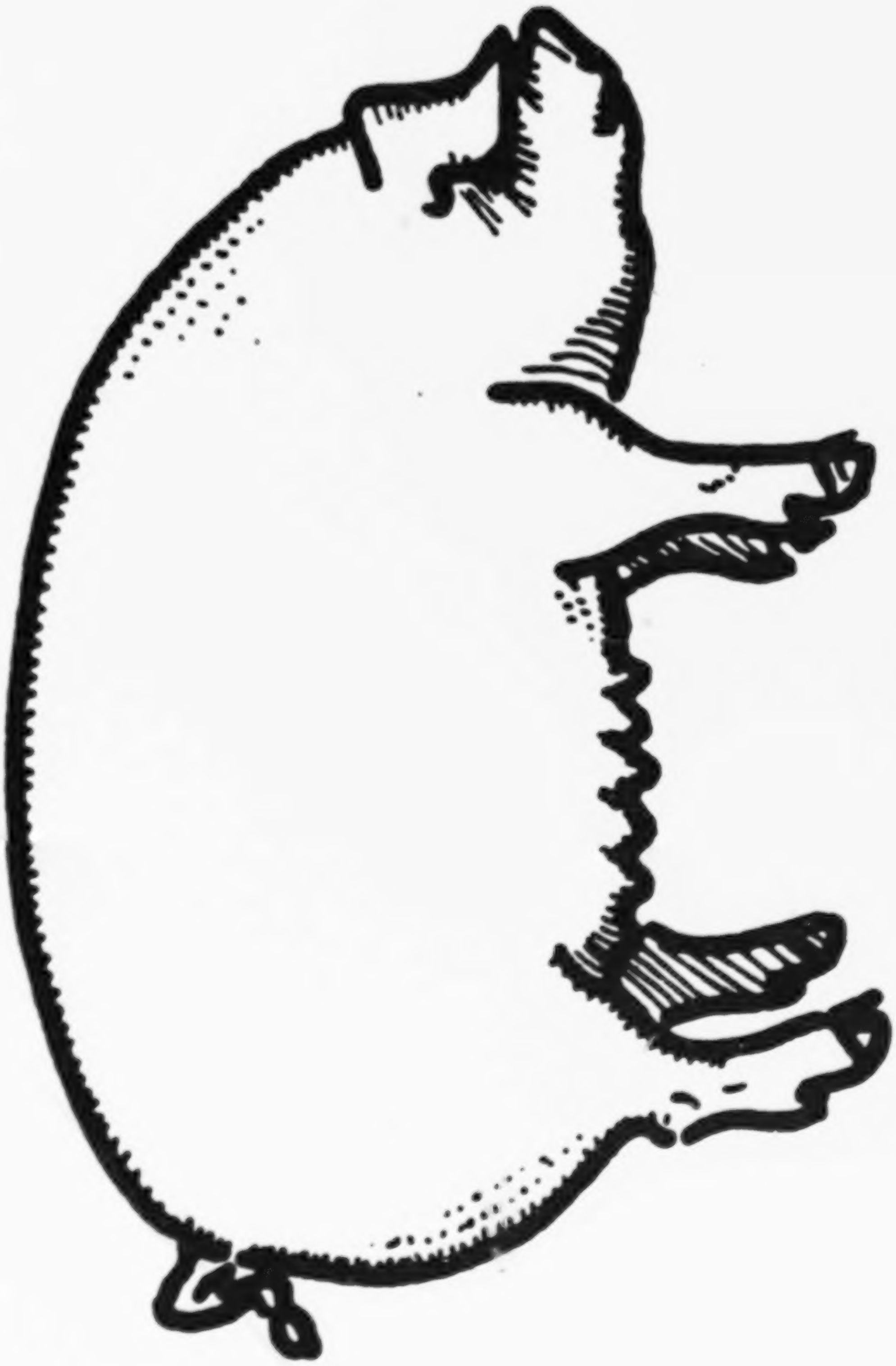
21 BELLY
22 TEATS
23 SHEATH
24 HIND FLANK
25 RUMP
26 TAIL
27 HAM
28 HOCK


BUTT
PICNIC
LOIN
BACON
HAM

WHOLESALE CUTS OF A PORK CARCASS

MAJOR PARTS OF A HOG


SMOOTH SHOULDER
UNIFORM WIDTH of BACK
FULL THICK LOIN
UNIFORM ARCH
LONG, FULL RUMP HIGH TAIL SETTING
DEEP THICK HAM
LONG, SMOOTH SIDE
TRIM UNDERLINE
DEEP FLANKS
STRAIGHT STRONG PASTERNS



Ideal Type--Side View

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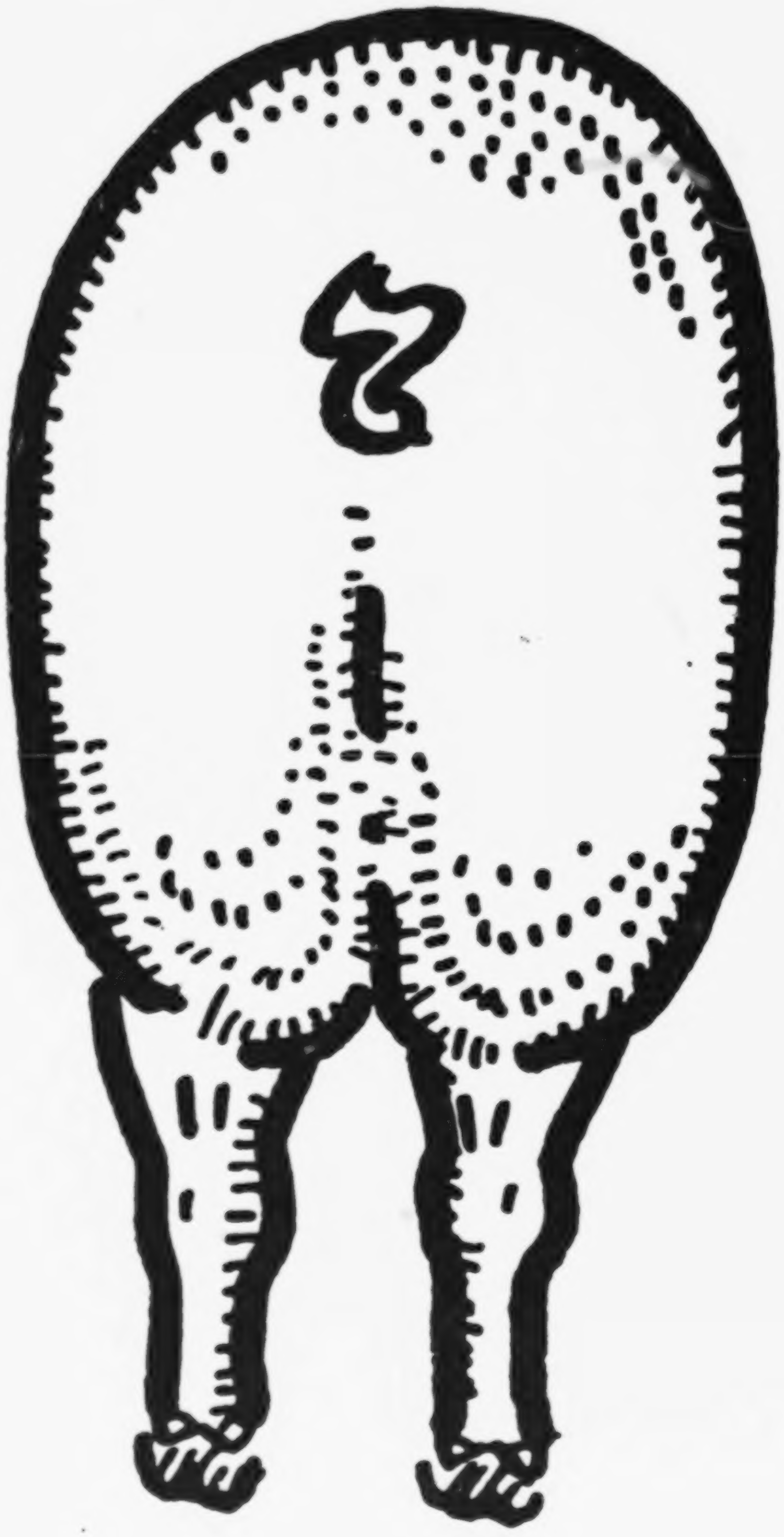
Ideal Type--Rear View



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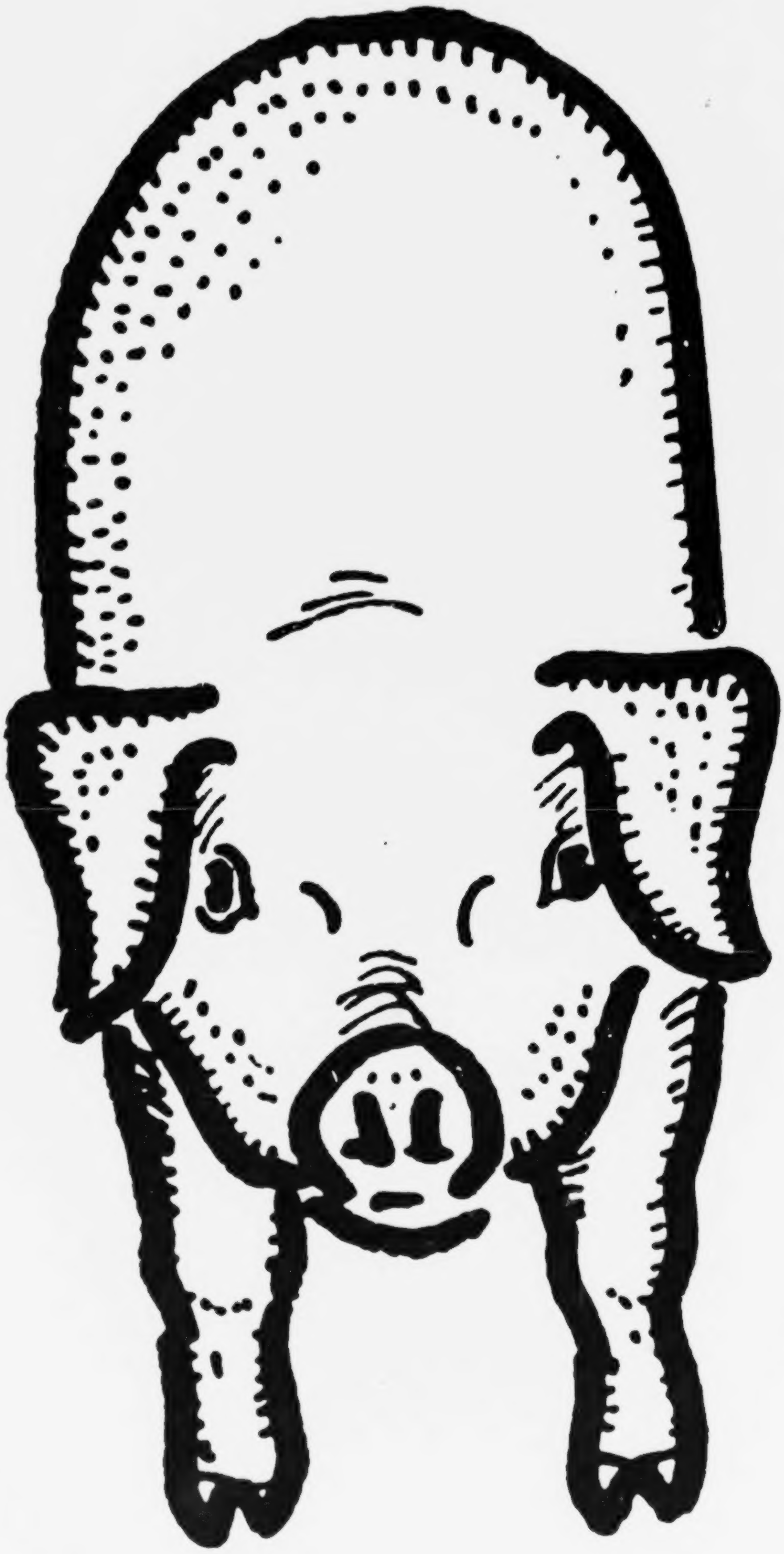
Ideal Type--Front View



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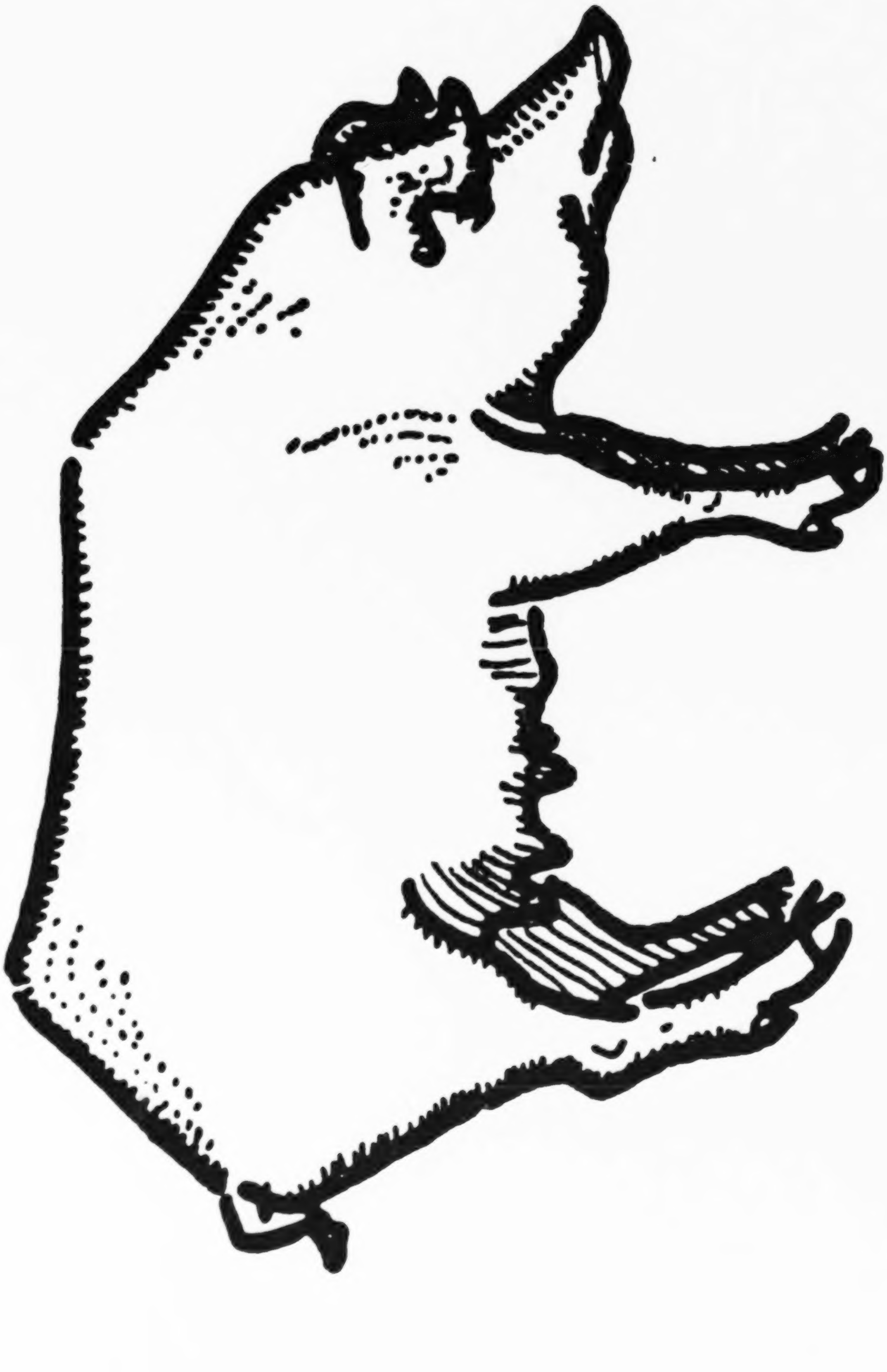
Common Faults--Side View



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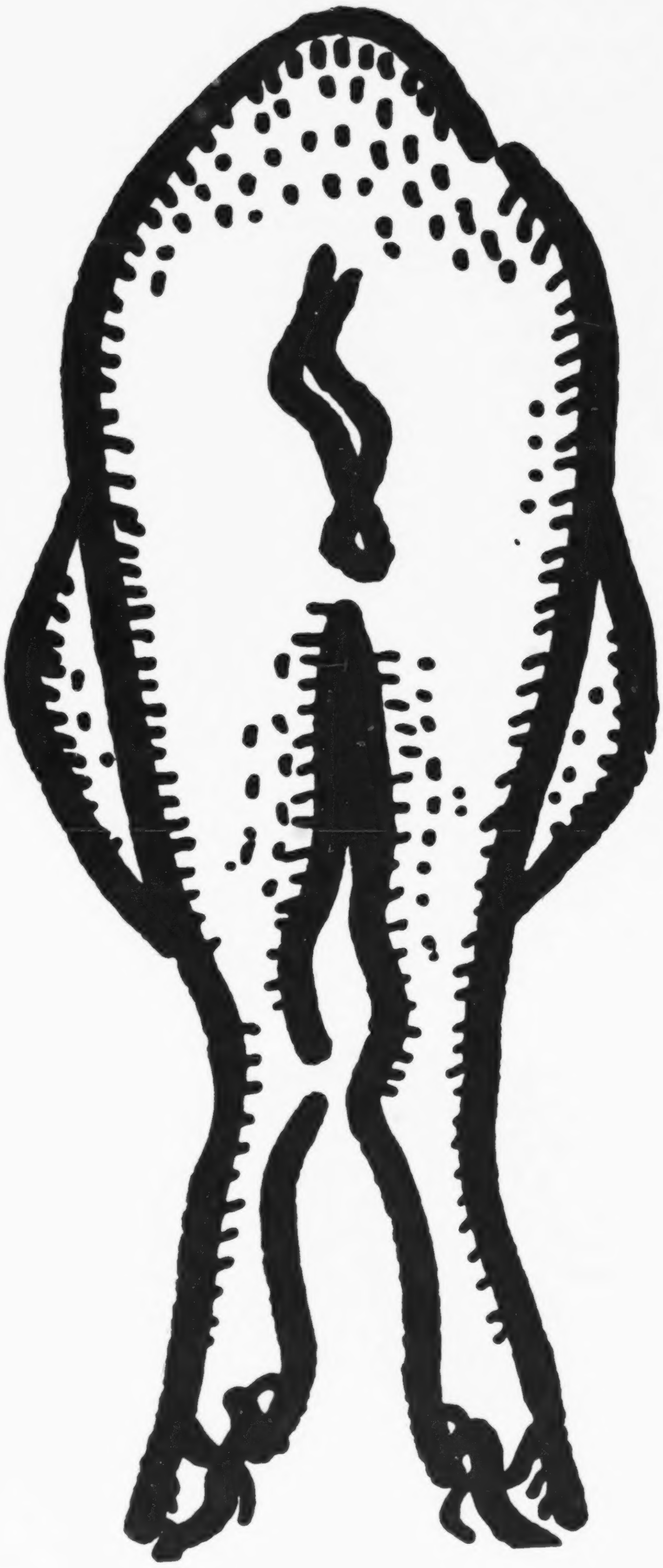
Common Faults--Rear View



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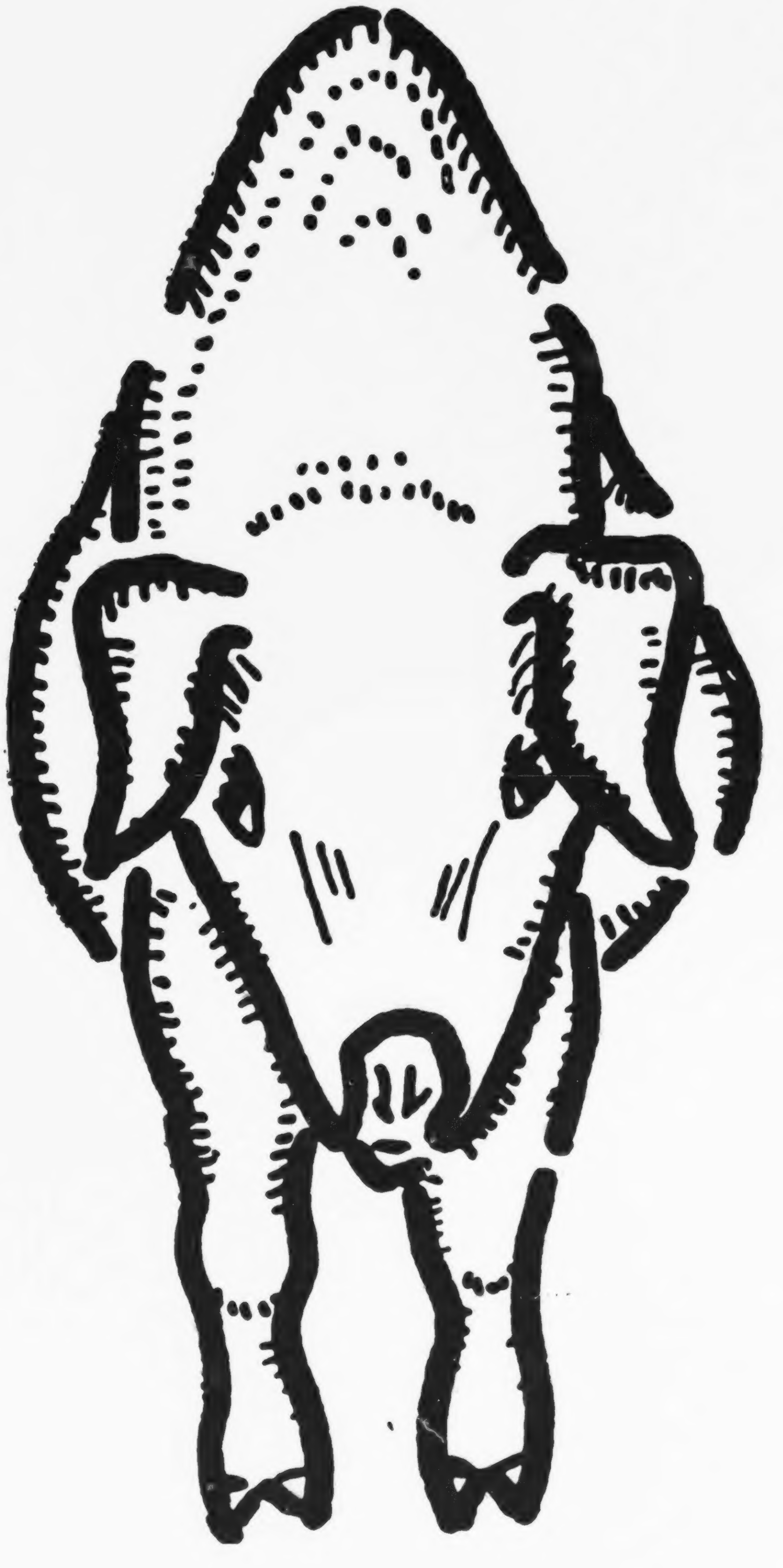
Common Faults--Front View



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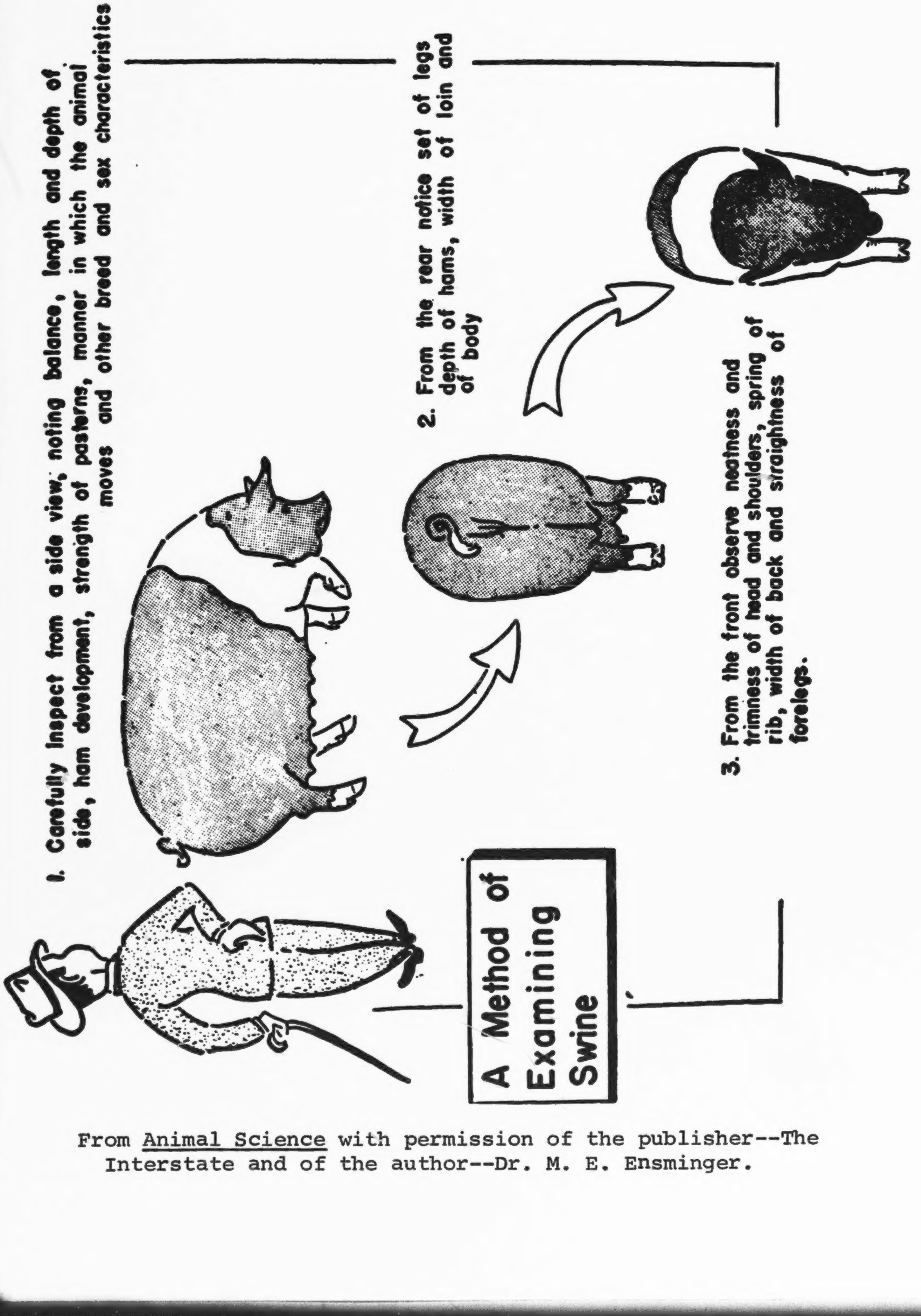

A Method of Examining Swine

1. Carefully inspect from a side view, noting balance, length and depth of side, ham development, strength of pasterns, manner in which the animal moves and other breed and sex characteristics

2. From the rear notice set of legs depth of hams, width of loin and of body

3. From the front observe neatness and trimness of head and shoulders, spring of rib, width of back and straightness of forelegs.

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HOG BREED CHARACTERISTICS

BREED	COLOR	EARS	ORIGIN
Berkshire	Black, 6-white points	Erect	England
Chester White	White	Droop	United States Pennsylvania
Duroc	Red	Droop	United States New York & New Jersey
Hampshire	Black with white belt	Erect	United States Kentucky
Hereford	Red with white face	Droop	United States Missouri
Oic	White	Droop	United States Ohio
Poland China	Black 6 white points	Droop	United States Ohio
Spotted Poland China	50% black 50% white	Droop	United States Indiana

Hog Breed Characteristics - continued

BREED	COLOR	EARS	ORIGIN
Tamworth	Red	Erect	England
Yorkshire	White	Erect	England
Landrace	White	Droop	Denmark

Lesson 6: Selecting Horses 2 days and 1 day field trip

OBJECTIVES:

1. To recognize some common breeds of horses.
2. To know fundamental characteristics of a sound, useful horse and to be able to recognize deviations from them.
3. To practice judgment in choosing between individuals.

REFERENCES:

Animal Science, pages 1017 - 1031

"Breed Study and Identification Kit"

		Page
Transparencies:	"Parts of a Horse" (unlabeled)	89
	"Parts of a Horse"	90
	"Side View--Ideal Type"	91
	"Rear View--Ideal Type"	92
	"Front View--Ideal Type"	93
	"Common Faults--Side View"	94
	"Common Faults--Rear View"	95
	"Common Faults--Front View"	96
Handout:	"Parts of a Horse" (unlabeled)	85
	"Breed of Horses"	97

MOTIVATION:

Horses are primarily recreational animals today, although riding horses do have real usefulness on some livestock farms. How are we going to decide what qualities we want in a horse if we aren't concerned about meat production or milk production?

Have you seen a horse you especially like? Why do you like this animal?

OUTLINE:

A. Parts of a Horse

B. Major Considerations in Selection Based on Type

C. Ideal Conformation in a Horse
   1. Side View
      a. high carriage of head, active ears, alert disposition, and beauty of conformation
      b. all parts well developed and nicely blended together

- c. fairly long neck; carried high; clean-cut about the throat latch; with head well set on
- d. sloping shoulders (about a 45° angle)
- e. a short, strong back and loin, with a long, nicely turned and heavily muscled croup, and a high, well-set tail; withers clearly defined and of the same height as the high point of croup
- f. a short coupling as denoted by the last rib being close to the hip
- g. ample middle due to long, well-sprung ribs
- h. well let down in the rear flank
- i. well-muscled arm, forearm, and gaskin
- j. straight, true, and squarely set legs; pasterns sloping about 45°; hoofs large, dense, and wide at the heels
- k. plenty of quality, as denoted by clean, flat bone, well-defined joints and tendons, refined head and ears, and fine skin and hair
- l. showing plenty of breed type

2. Rear View
    - a. wide and muscular over the croup and through the rear quarters
    - b. straight, true, and squarely set

3. Front View
    - a. head well proportioned to rest of body, refined, clean cut, with chiseled appearance; broad, full forehead with great width between the eyes; jaw broad and strongly muscled; ears medium sized, well carried and attractive
    - b. refinement and femininity in the brood mare; boldness and masculinity in the stallion
    - c. a deep, wide chest
    - d. straight, true, and squarely set.

D. Common Faults in Conformation

1. Side View
    - a. lacking style and beauty
    - b. lacking in balance and symmetry
    - c. a short, thick neck; ewe-necked
    - d. straight in the shoulders
    - e. sway backed; steep croup
    - f. long in the coupling
    - g. lacking middle
    - h. high cut rear flank or "wasp waisted"
    - i. light-muscled arm, forearm, and gaskin

        j. crooked legs; straight pasterns; hoofs small, contracted at the heels, and shelly
        k. lacking quality
        l. lacking breed type
    2. Rear View
        a. lacking width over the croup and muscling through the rear quarters
        b. crooked hind legs
    3. Front View
        a. plain headed; weak jaw
        b. mares lacking femininity; stallions lacking masculinity
        c. a narrow chest
        d. crooked front legs

E. Soundness

F. Action
    1. Walk - easy, prompt, balanced; a long step, with each foot carried forward in a straight line; feet lifted clear of the ground.
    2. Trot - rapid, straight, elastic trot, with the joints well flexed.
    3. Canter - slow, collected canter, which is readily executed on either lead

G. Judging a Class of Horses (Procedure)

H. Important Breed Characteristics

PROCEDURES:

1. Discuss importance of knowing the names of parts so we can talk about good and bad parts of animals and all be describing the same thing. Show the transparency and let sutdents label as many as they can correctly. Give students an unlabeled handout sheet. Then show the labeled transparency and have students finish labeling their handout. Tell them how many of the parts you expect them to learn and how soon.

2. Show pictures of some horses of good type. Why are these desirable animals?

3. Show the "Side View--Ideal Horse." How many desirable characteristics can you point out? Use the Outline C.1 to point out desired characteristics.

4. Show the "Rear View--Ideal Horse." Use the Outline C.2 to point out desired characteristics.

5. Show the "Front View--Ideal Horse." Use the Outline C.3 to point out desired characteristics.

6. What would be some common faults in the side view? What do you suppose a faulty side view will look like? Show the common faults and discuss them. Compare with the ideal and try to fix ideal type in their minds.

7. Discuss common faults of the rear view. Show the transparency. Compare with the ideal and try to fix ideal view in their minds.

8. Discuss common faults of the front view. Show the transparency. Compare with the ideal and try to fix the ideal type in their minds.

9. What are some common evidences of unsoundness in horses?

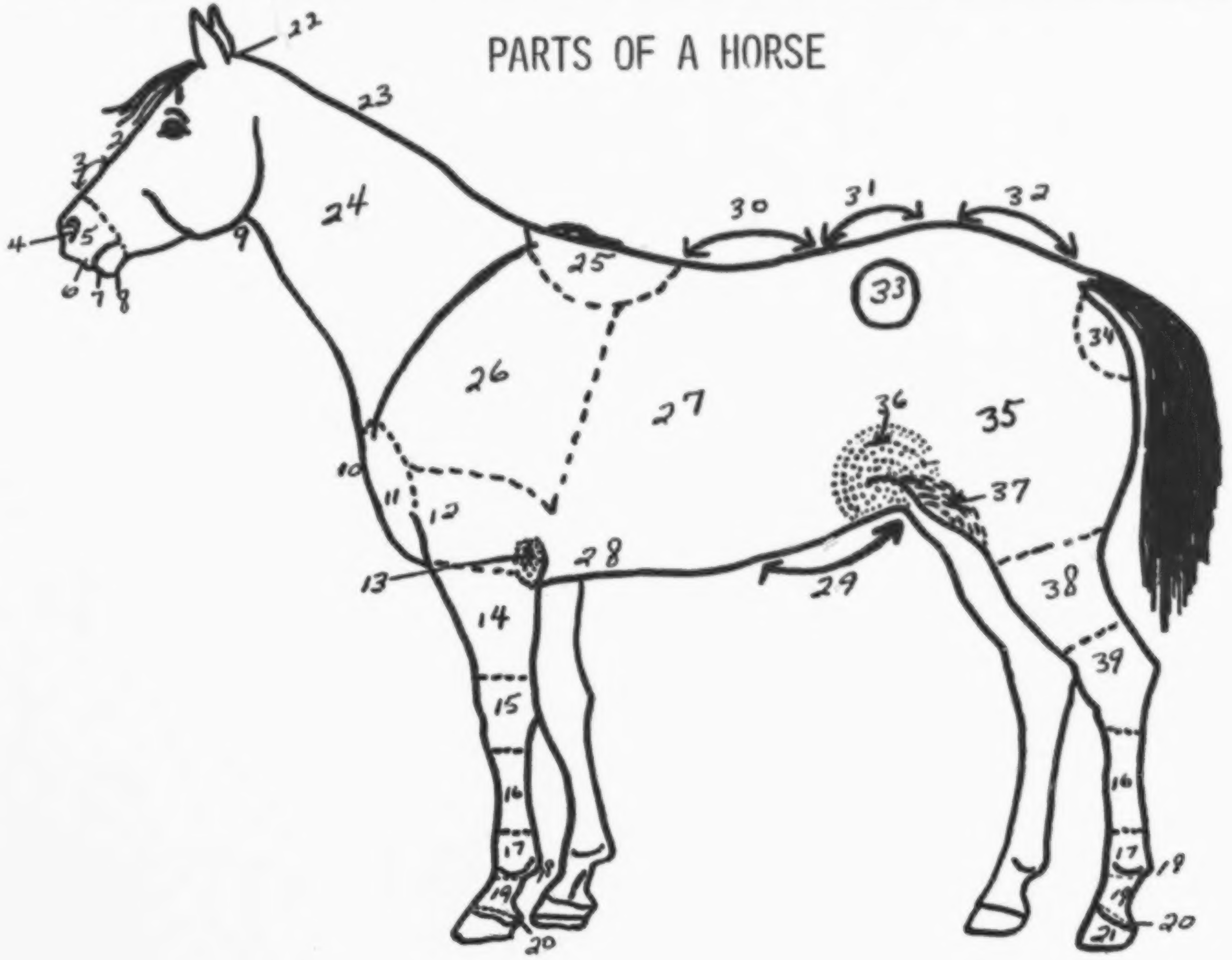
10. Why is action so important in judging horses? How should a horse walk? Trot? Canter?

11. Describe the procedure for judging a class of horses.

12. Show pictures of some common breeds. Briefly discuss which breed is best, then hand out the sheet on breed characteristics. Tell students how much of this you expect them to learn.

SUMMARY:

PARTS OF A HORSE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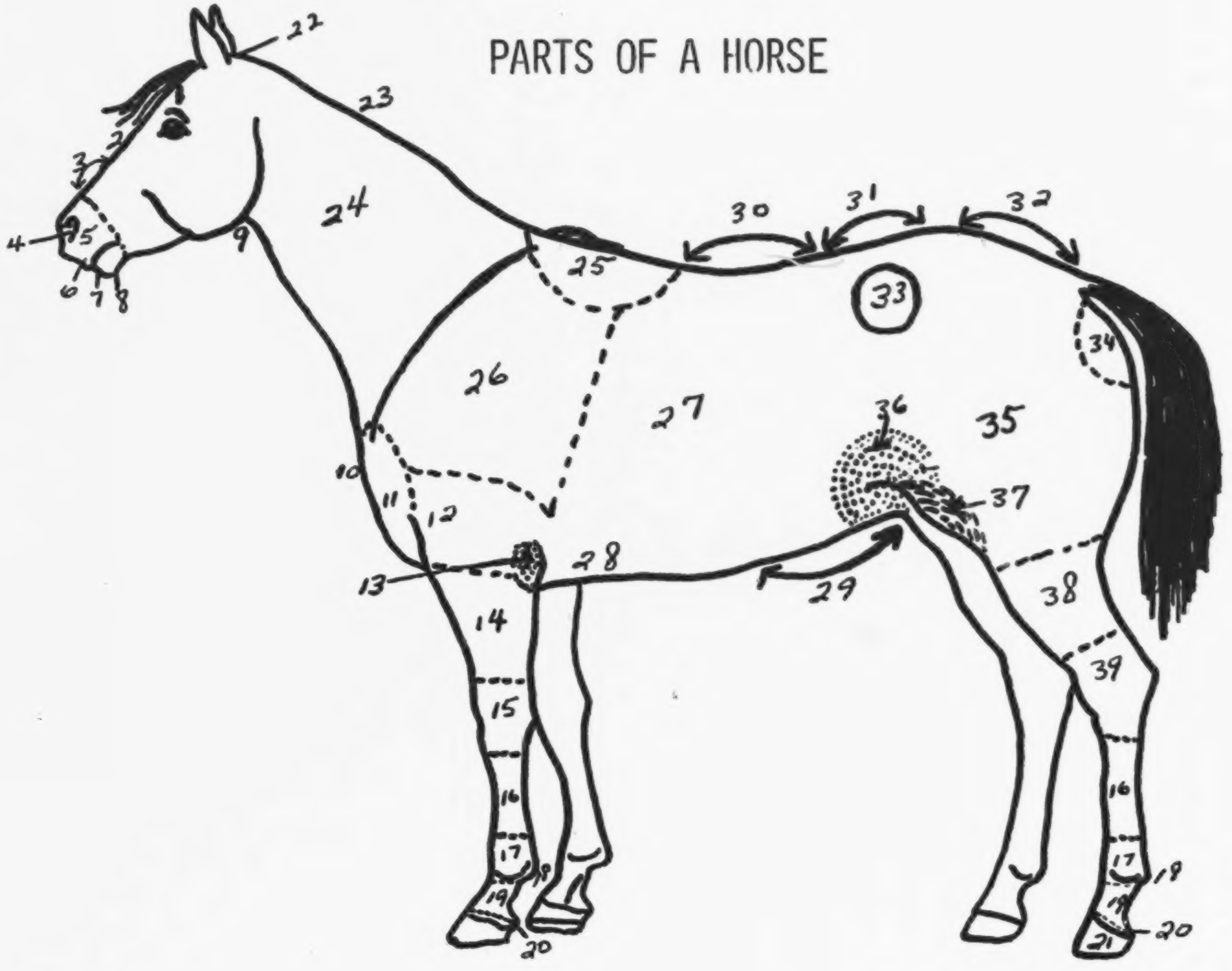
PARTS OF A HORSE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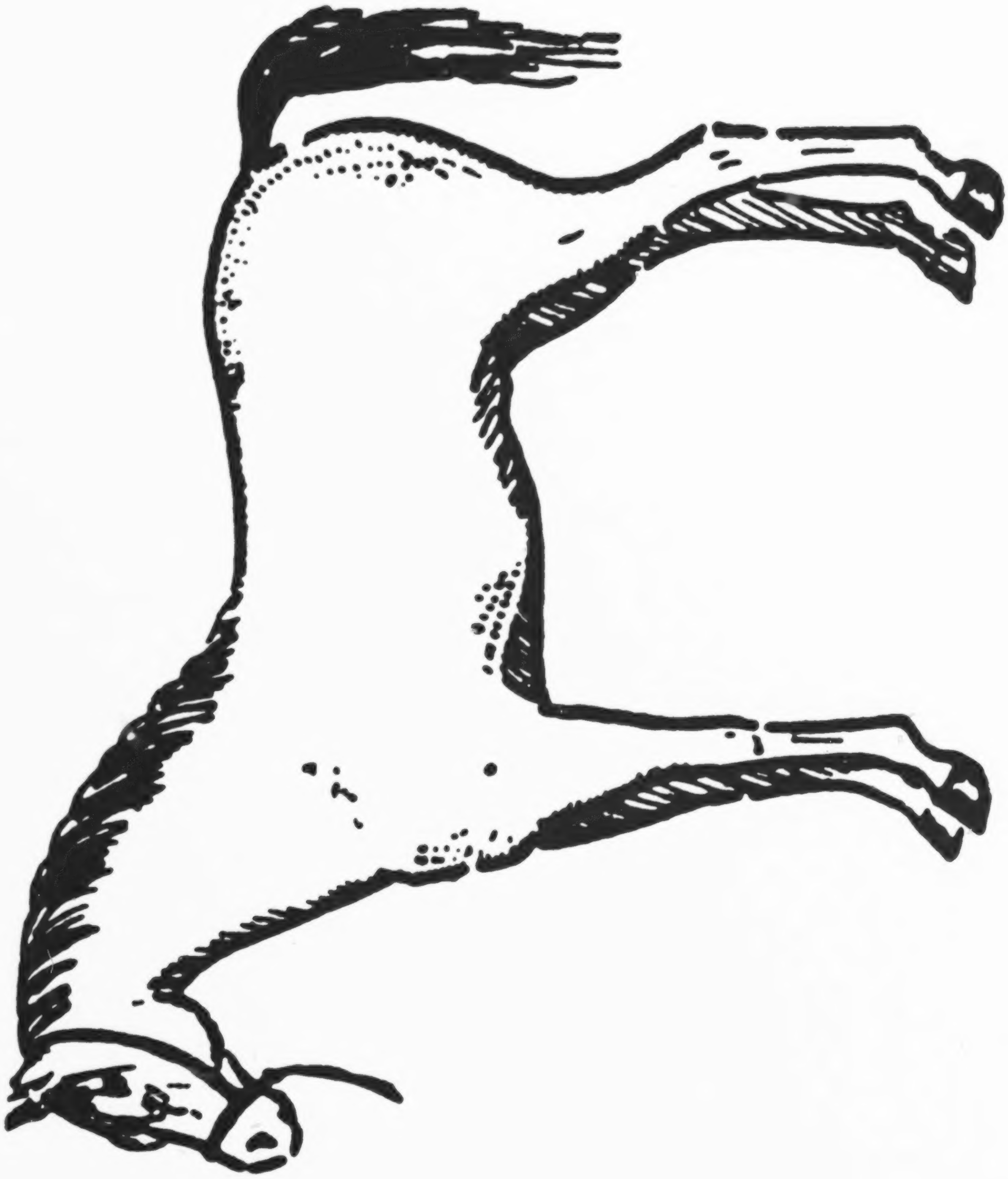
1	FOREHEAD	11	CHEST	21	HOOF	31	LOIN
2	FACE	12	ARM	22	POLL	32	RUMP
3	BRIDGE OF NOSE	13	ELBOW	23	CREST	33	POINT OF HIP
4	NOSTRIL	14	FOREARM	24	NECK	34	BUTTOCK
5	MUZZLE	15	KNEE	25	WITHERS	35	THIGH
6	UPPER LIP	16	CANNON	26	SHOULDER	36	FLANK
7	LOWER LIP	17	ANKLE	27	BARREL	37	STIFLE
8	UNDER LIP	18	FETLOCK	28	GIRTH	38	GASKIN
9	THROAT LATCH	19	PASTERN	29	ABDOMEN	39	HOCK
10	POINT OF SHOULDER	20	CORONET	30	BACK		



Ideal Type--Side View

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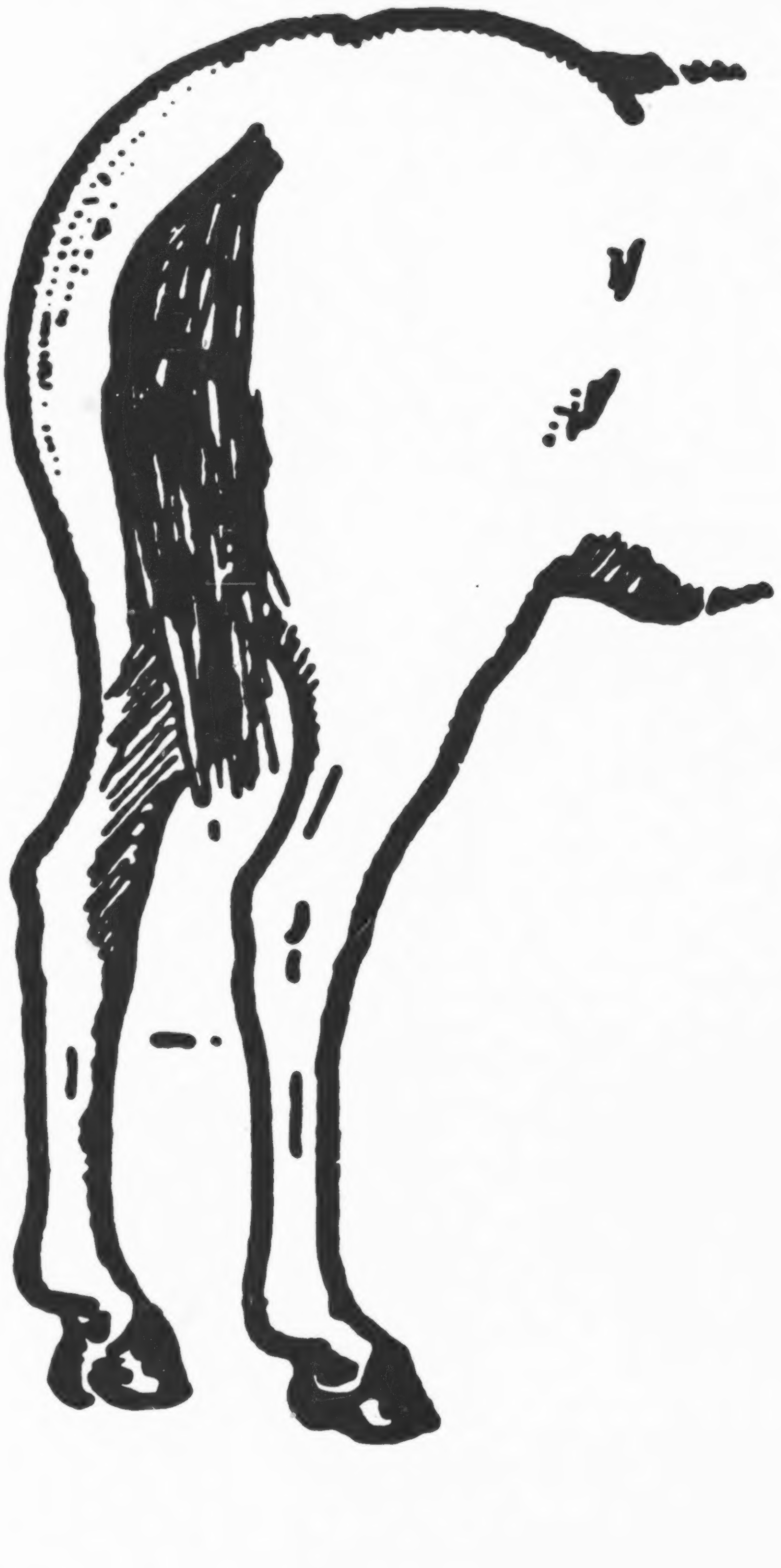
Ideal Type--Rear View



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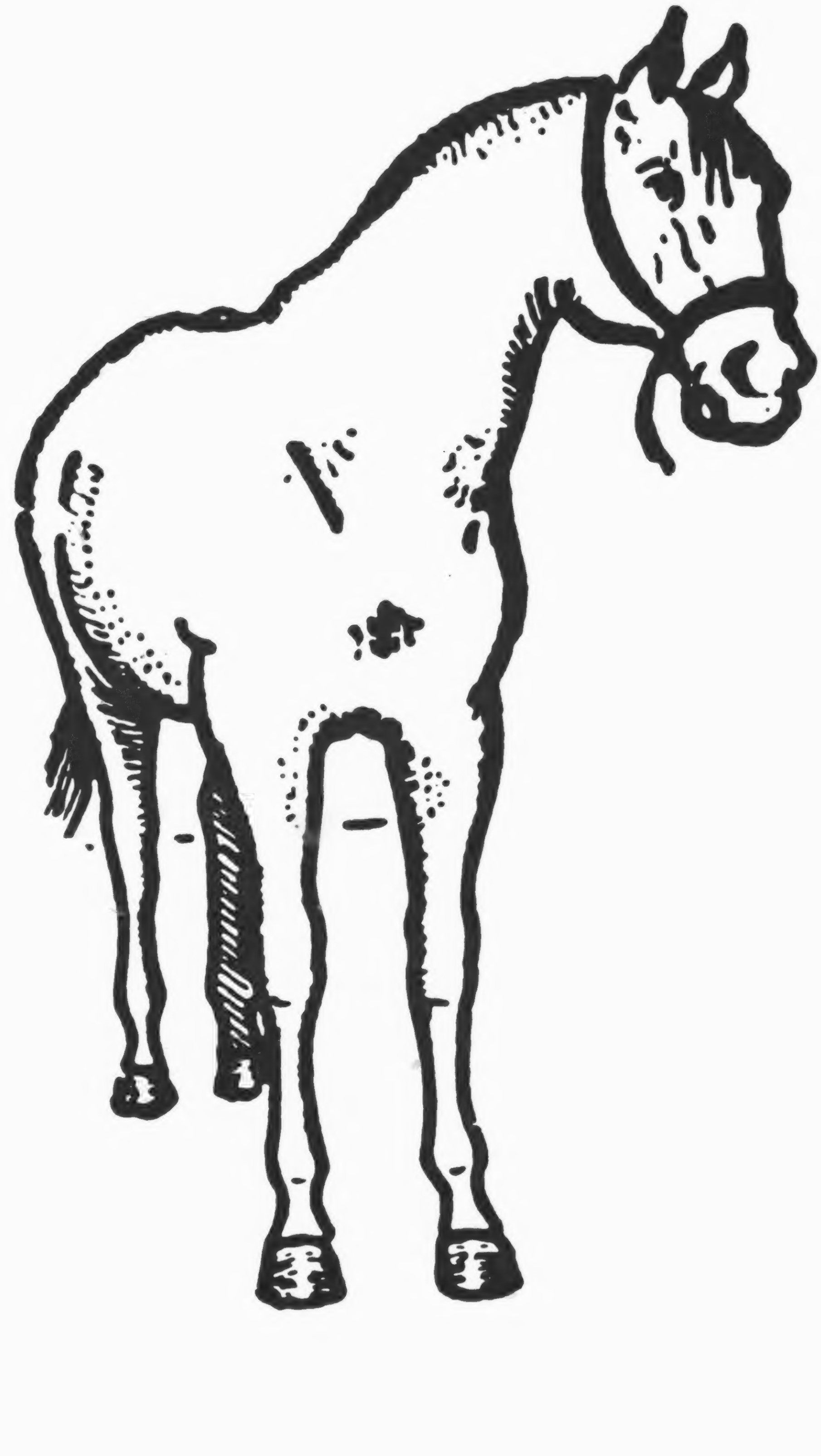
Ideal Type--Front View



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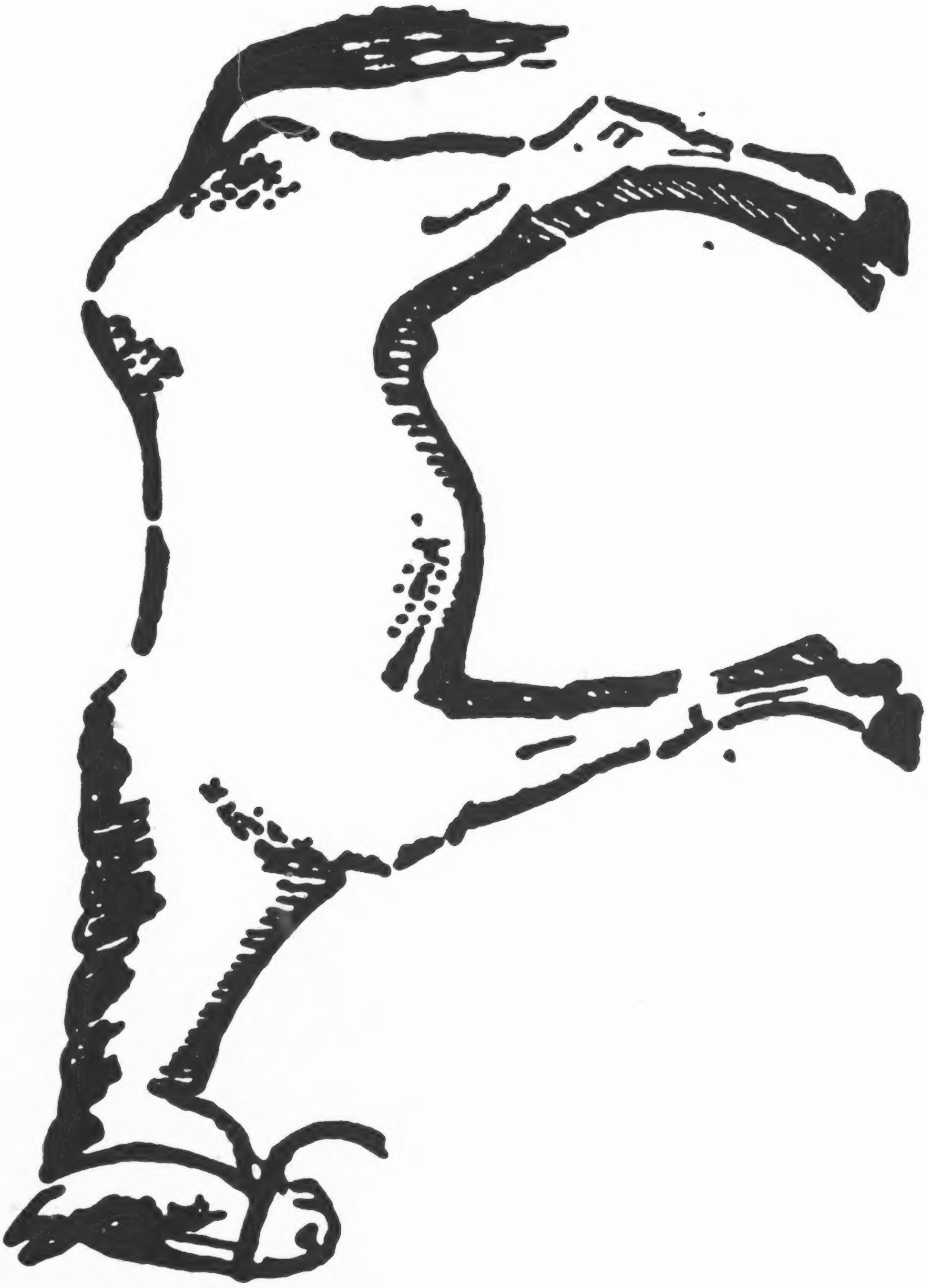

Common Faults--Side View

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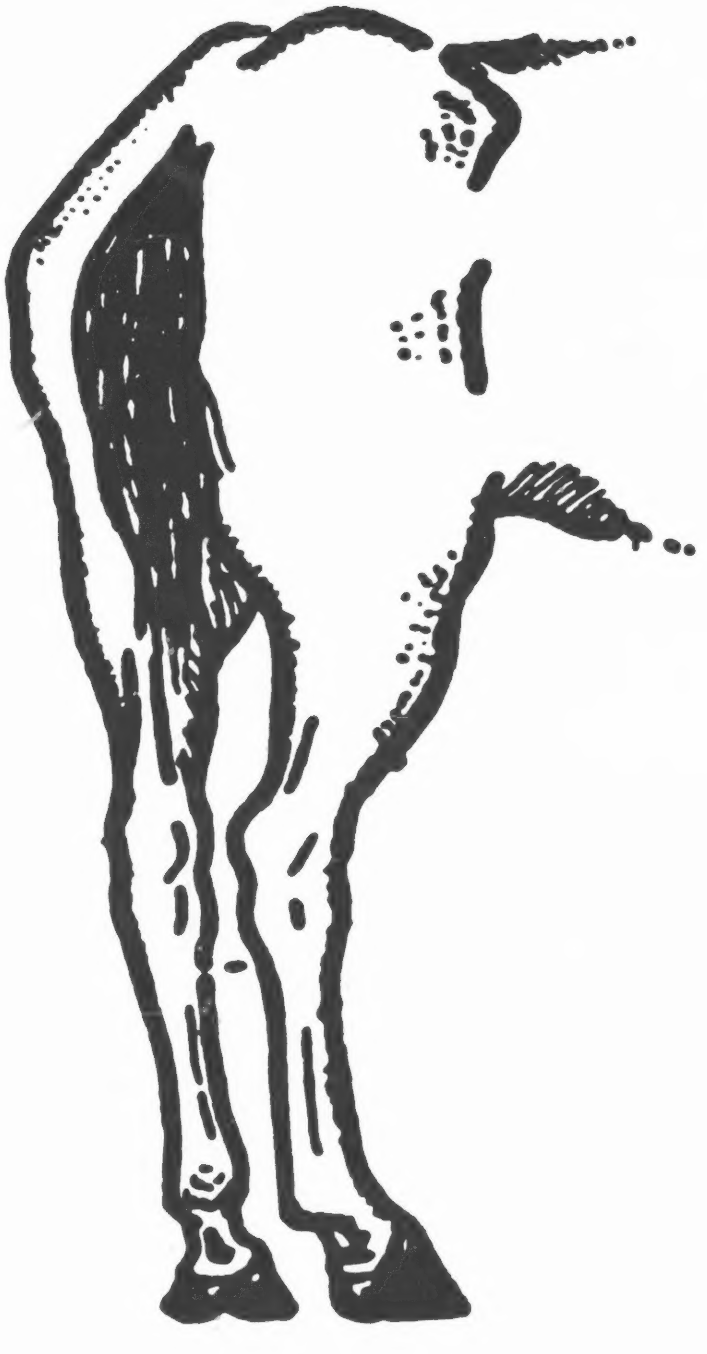
Common Faults--Rear View



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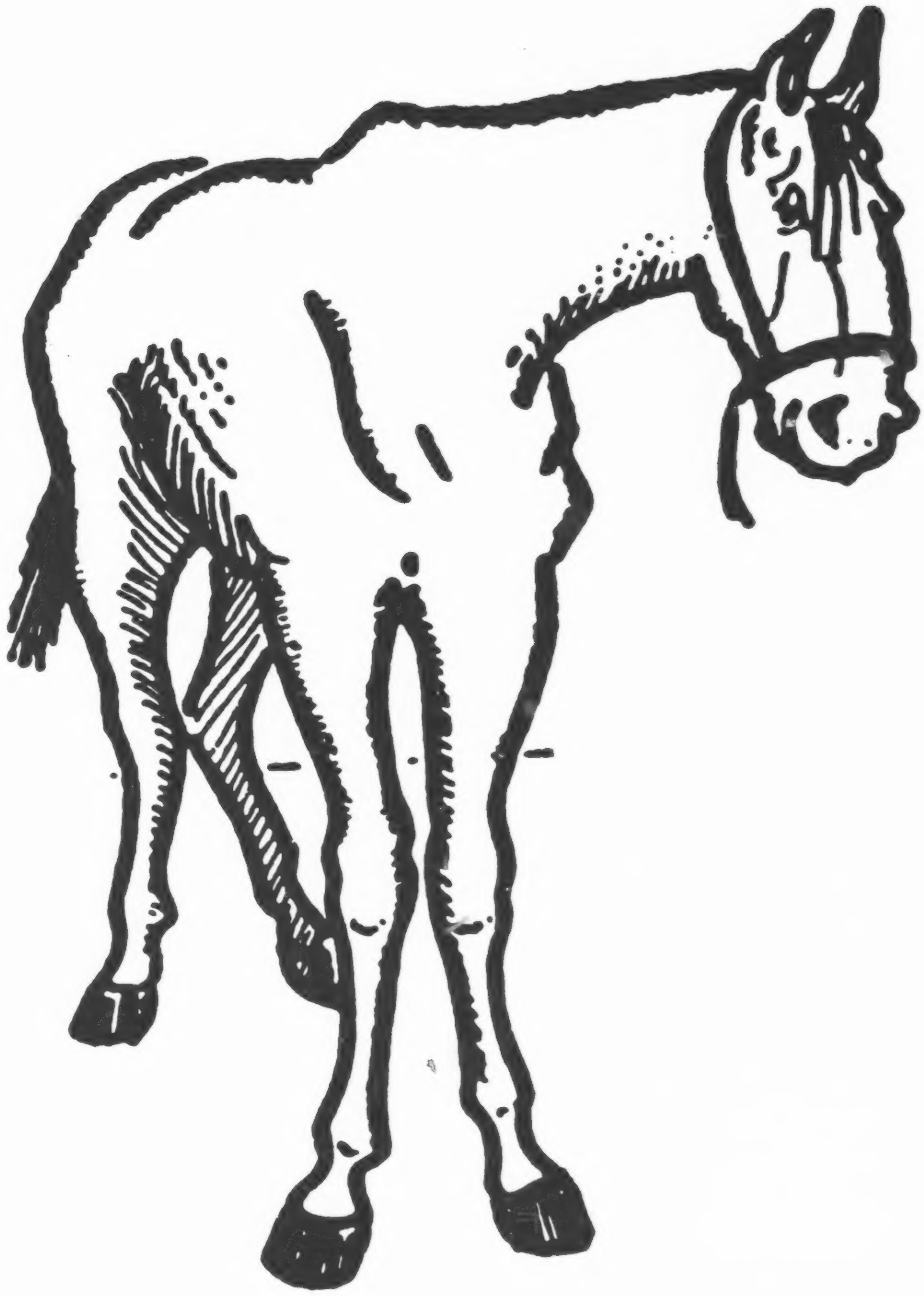
Common Faults--Front View



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BREEDS OF HORSES

BREED	USE	ORIGIN	COLOR
		LIGHT HORSES	
American Saddle	3-5 gaited saddle fine harness stock, pleasure	United States	Bay, brown, chestnut, gray, black, golden
Arabian	3-gaited saddle stock, pleasure	Arabia	Bay, gray, chestnut, occasional white & black
Appaloosa	3-gaited saddle stock, pleasure	United States	White over loin and hips with dark, round, or egg shaped spots-eye encircled by white
Morgan	3-gaited saddle stock, pleasure	United States	Bay, brown, black, chestnut & white markings
Palomino	3-gaited saddle stock, pleasure	United States	Golden-light colored mane & tail
Thoroughbred	3-gaited saddle stock polo hunter jumper race	England	Bay, brown, chestnut, black & gray
Tennessee Walking	3-5 gaited walking	United States	Sorrel, chestnut, black, roan, white, bay, brown, gray & golden
Hackney	Driving heavy harness	England	Chestnut, bay, brown, roan & black
Mo. Fox Trotting	Trail riding pleasure	Missouri	Sorrel, golden, black bay, chestnut, and gray
Quarterhorse	Racing stock	United States	Chestnut, sorrel, bay, dun, palomino, black, brown, roan

Breeds of Horses - continued

BREEDS	USE	ORIGIN	COLOR
		Light Horses - cont.	
Shetland	Driving, harness, riding	Shetland Islands	All colors, broken and solid
Welch	Driving, harness, pleasure	England	Gray, roan, black brown, chestnut
		DRAFT HORSES	
Belgian	Work	Belgium	Bay, chestnut, roan
Clydesdale	Work	Scotland	Bay, brown, white markings
Percheron	Work	France	Bay, brown, roan, chestnut
American Cream	Work	United States	Cream-white mane and tail
Shire	Work	England	Bay, brown, black

Animal Science

Lesson 7: Selecting Dairy Cattle 2 days and 1 day field

OBJECTIVES:

1. To recognize the principal breeds of dairy cattle.
2. To know the meaning of desired type and to recognize important deviations from accepted type.
3. To understand the essential features of testing programs which are helpful in selecting dairy cattle.
4. To practice using judgment in choosing among individuals.

REFERENCES:

Breed association literature

Livestock and Poultry Production, pages 299 - 320

"Dairy Cow Unified Score Card"

"Dairy Bull Unified Score Card"

Hoard's Dairyman Annual Picture Judging Contest

"Understand Your DHIA Records"

"Sample Dairy Herd Improvement Association Record"

"Annual Missouri DHIA Summary"

Pa

Transparencies: "Annual Milk Production Per Cow"
"Butterfat Production and Income Over Feed Cost"
"Production By Breeds"
"Minimum Production Level at which Income Equals 2 x Feed Cost"
"Dairy Economics"
"Operator Income At Various Herd Sizes and 3 Levels of Production"
"Average Charges For Supervisor Services"
"Indices of Heritabilities of Dairy Cattle Traits"

Handout: "Dairy Breeds"

4. Discuss the "Dairy Cow Unified Score Card." Provide a copy for each student. Have students find the important items. What are the big differences between beef type and dairy type? Be sure students have at least a general idea of the meaning of the four major headings on the score card.

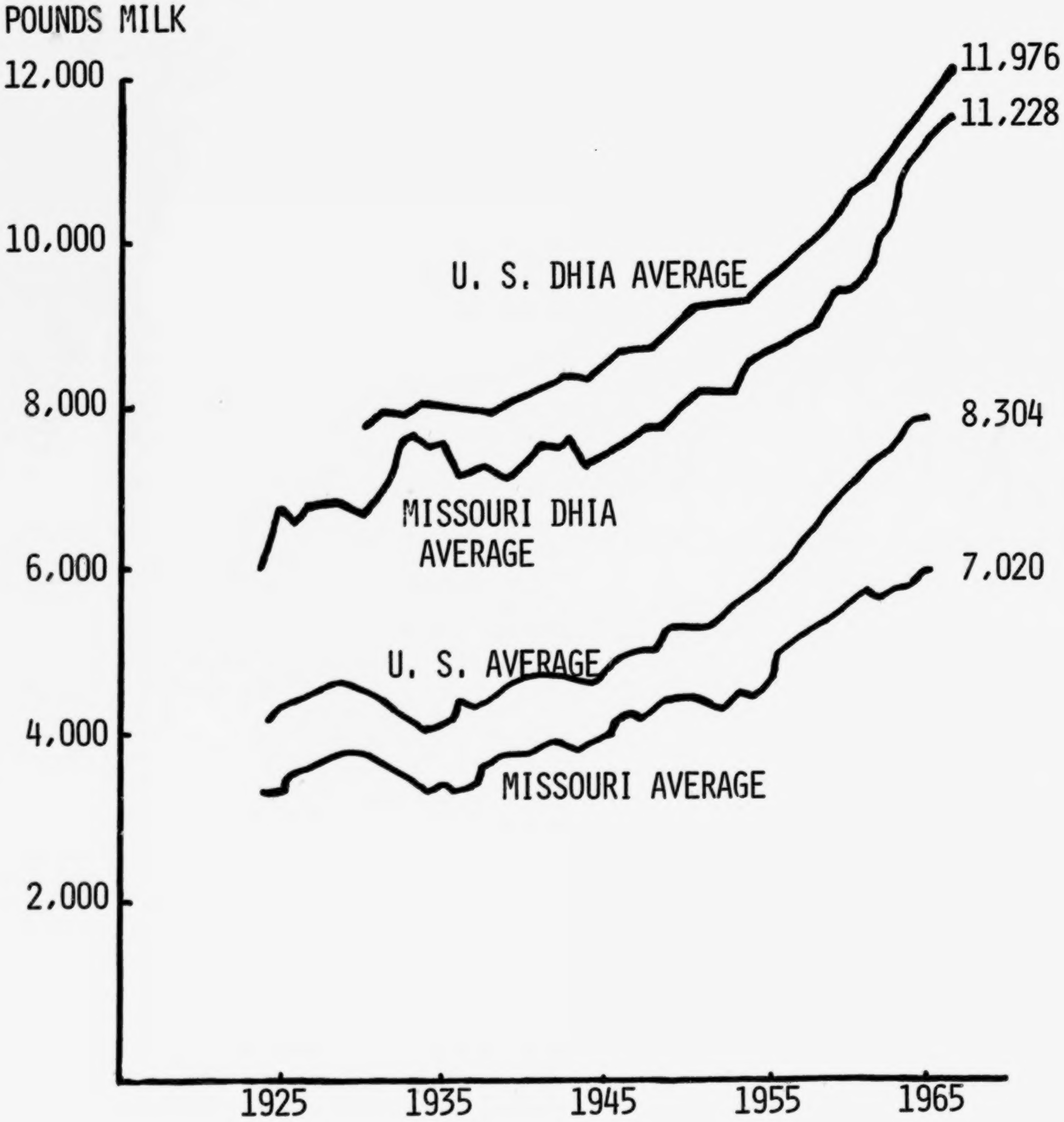
5. Discuss the "Dairy Bull Unified Score Card" to point out principal differences between scoring or placing cows and bulls.

6. Participate in the Hoard"s Dairyman Judging Contest.

7. Show "Indices of Heritabilities of Dairy Cattle Traits."

SUMMARY:

ANNUAL MILK PRODUCTION PER COW



Courtesy Dr. Alfred Lane, University of Missouri

BUTTERFAT PRODUCTION AND INCOME OVER FEED COST

Fat Lbs.	No. Herds	Milk Lbs.	Fat Lbs.	Income Over Feed Cost	Feed Cost /cwt.Milk
175-224	2	4,776	205	$ 76	$2.24
225-274	3	7,229	256	$108	$2.66
275-324	18	8,158	303	$174	$2.13
325-374	45	8,886	355	$205	$2.13
375-424	82	10,556	402	$251	$1.94
425-474	96	11,537	446	$285	$1.93
475-524	80	12,961	495	$321	$1.85
525-574	28	13,920	545	$360	$1.84
575-624	6	15,843	590	$415	$1.59
625-674	2	17,662	642	$498	$1.45
675-724	1	18,544	678	$412	$1.80

Courtesy Dr. Alfred Lane, University of Missouri

PRODUCTION BY BREEDS - 1966

BREED	Missouri No. Herds	Missouri Milk Lbs.	Missouri % Bf.	Missouri Lbs. Bf.	U.S. Milk Lbs.	U.S. Lbs. Bf.
Guernsey	31	8,975	4.7	425	9,179	436
Holstein	263	12,333	3.6	448	12,684	466
Jersey	36	8,381	5.2	433	8,319	423
Brown Swiss	6	9,866	4.0	399	10,860	446
Milking Shorthorn	5	8,724	4.0	346	8,585	319
Other	19	9,475	4.1	390		

Courtesy Dr. Alfred Lane, University of Missouri

MINIMUM PRODUCTION LEVEL AT WHICH INCOME EQUALS 2X FEED COST

Breed	Milk Level
Ayrshire	8,105
Guernsey	6,126
Holstein	9,071
Jersey	4,982
Brown Swiss	9,086
Milking Shorthorn	7,934

Courtesy: Dr. Alfred Lane, University of Missouri

DAIRY ECONOMICS

EQUIPMENT COSTS - Charged against high and low producers

FEED COSTS - 2.00 of milk for each $ of feed eaten to be profitable

LABOR - Same for high--low producers (Wages of operator paid only after all other costs are paid)

DO RECORDS PAY?

MICHIGAN RESULTS - 100 HERDS - NO RECORDS

	50 Started Records	50 No Records
1 YEAR LATER Milk	-1,200 lb./cow	No change
2 YEARS LATER Milk	-1,600 lb./cow	No change

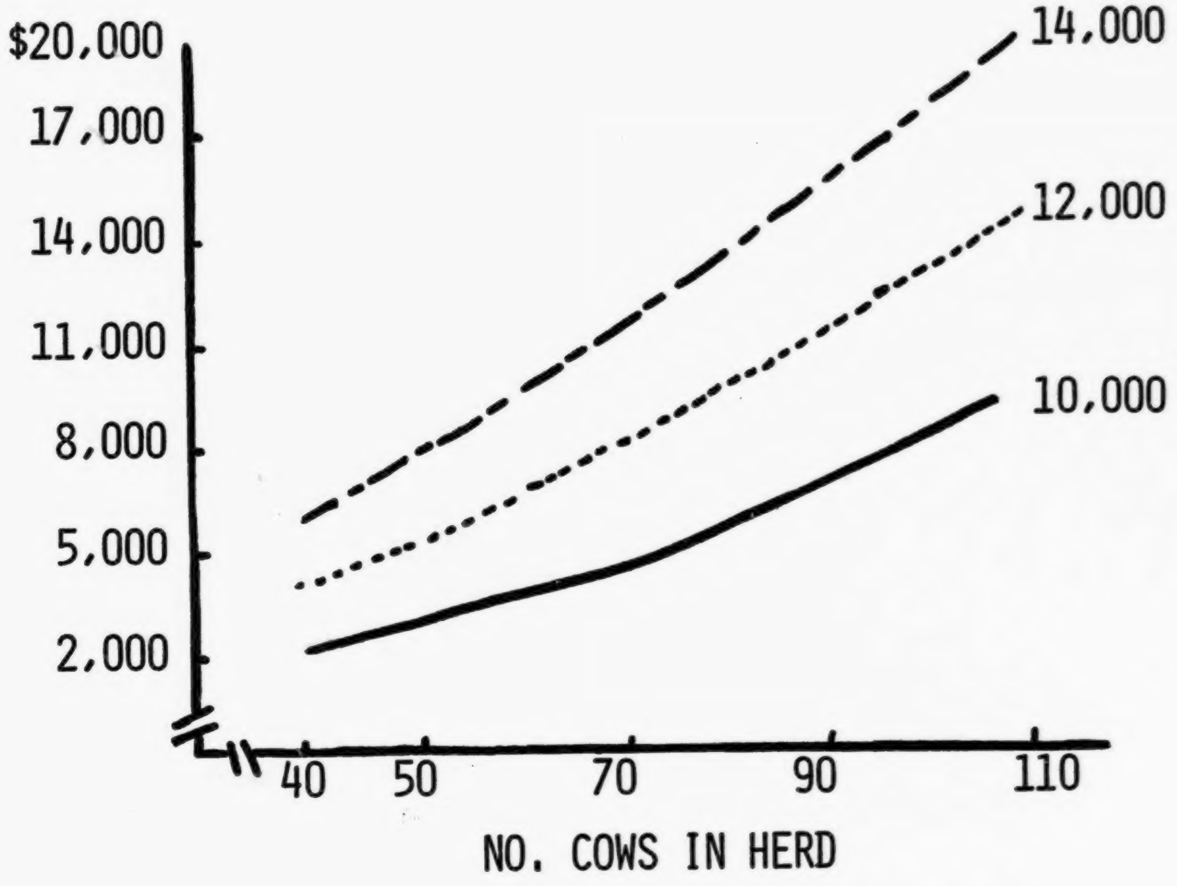
INCOME INCREASE $44/cow

AVERAGE COST OF RECORDS $6.10/cow

Courtesy Dr. Alfred Lane, University of Missouri

OPERATOR INCOME AT VARIOUS HERD SIZES AND 3 LEVELS OF PRODUCTION

(WISCONSIN BULLETIN 579)



40 COW HERD 10,000# = $2,212.00
13,000# = $5,020.00

WHICH IS MOST IMPORTANT--A LARGE HERD OR HIGH PRODUCTION?

Courtesy Dr. Alfred Lane, University of Missouri

AVERAGE CHARGES FOR SUPERVISOR SERVICES (Missouri)

	Number of Cows			
	30	40	60	100
DHIA-DHIR				
Average of top 1/3	$14.69	$17.39	$23.19	$34.54
Average of all reporting	12.39	15.01	20.39	30.85
Owner-Sampler				
Average of all reporting	6.65	8.23	11.38	17.90

Courtesy Dr. Alfred Lane, University of Missouri

INDICES OF HERITABILITIES OF DAIRY CATTLE TRAITS

Milk fat percentage	60
Solids-not-fat percentage	60
Protein percentage	60
Height at withers	50
Body weight	40
Fat production	30
Milk production	30
First lactation milk yield	30
Dairy character	25
Lactation persistency	20
Milking speed	20
Mastitis resistance	20
Ketosis resistance	20
Milk fever resistance	20
Final type rating	20
Udder	20
Feet and legs	20
Breeding troubles	10
Service per conception	10
Longevity	10
Temperament	10

Courtesy Dr. Alfred Lane, University of Missouri

DAIRY BREEDS

BREED	Jersey	Guernsey	Holstein	Ayrshire	Brown Swiss	Milking Shorthorn	
Origin	Is. of Jersey	Is. of Guern.	Holland	Scotland	Switzerland	England	
Color	Fawn with occasional white markings	Orange fawn and white	Black and white	Red or reddish brown and white	Light fawn to black	Red and white Red, white or roan	
Size (Cows) (lbs.) (Bulls)	1000 1500	1100 1700	1500 2200	1200 1050	1400 2000	1200-1500 2000-2500	
							All Breeds
1965-66 Milk (lbs) D.H.I.A. B.F. (%) (U.S.) B.F. (lbs)	8,319 5.1 423	9,179 4.7 436	12,684 3.7 466	10,312 4.0 415	10,860 4.1 446	8,585 3.7 319	11,956 3.8 456
World Records (milk)	Challenger's Joyce M. 26,364 F. 1,212	Mill Farm Poppy M. 29,665 F. 1,190	Green Meadow Lily Pabst M. 42,805 F. 1,246	Middle Park Fancy Madge M. 26,731 F. 1,072	Lee's Hill Keepers Raven of Lee's Hill M. 34,851 F. 1,579 2X-305 D	Melba 15th of Darbalara M. 32,522 F. 1,614	
World Records (fat)	Victory S.C. Welcome Fan M. 24,088 F. 1,384 2X-365 Age 3-10	Langmeadow Minnie M. 26,695 F. 1,461 (2X)	Princess Breezewood RA Patsy M. 36,821 F. 1,866 (2X)	Chayrmel Queenie M. 23,500 F. 1,079	Letha Ireme Pride M. 34,811 F. 1,733 (3X) Gearing's Verna Karen 365 2X M. 29,266 F. 1,415	Same as above	
Color of milk	2	1	6	3	5	4	

Courtesy Dr. J. R. Campbell, University of Missouri

Lesson 8: Selecting Poultry 2 days and 1 day field trip

OBJECTIVES:

1. To recognize common breeds and classes of poultry.
2. To recognize desirable characteristics of laying hens.

REFERENCES:

Livestock and Poultry Production, pages 559 - 577.

Culling Hens, FB2216; "Weeding with Geese", MU Guide 8922.

		Page
Transparencies:	"Parts of a Hen"	114
	"It Pays to Cull"	115
	"Production of Caged Hens - Culled and Unculled"	116

MOTIVATION:

Show color pictures of various breeds of chickens. Which of these would be most profitable for egg production? Meat production? Why do you think so?

OUTLINE:

A. Parts of a hen

B. Culling for egg production
  1. Comb and wattles
     Layers - large, red, waxy
  2. Brightness of eye
  3. Body capacity
     a. Width - between pubic bones
     b. Depth - pubic bones to keel
  4. Handling quality
     Layer - soft, pliable
  5. Pigment - Order of disappearance
     a. Vent, 1 week
     b. Eye ring, 2 - 3 weeks
     c. Ear lobe, 3 - 4 weeks
     d. Beak, 6 weeks
     e. Shanks, 2- 5 months
  6. Molt

C. Classes and Breeds of Chickens
   1. American Class
   2. Mediterranean Class
   3. English Class
   4. Asiatic Class

D. Other Poultry
   1. Turkeys
   2. Ducks
   3. Geese

PROCEDURES:

1. Thumb through a Standard of Perfection and stop and show some of the more interesting pictures of poultry to the class. Have students make a list of the kinds of poultry. Be sure to include chickens - meat, egg, game, bantams; ducks; geese; and turkeys. Can students think of other kinds? (The Standard does not have a table of contents, but the index at the back is quite satisfactory.)

2. Show "Parts of a Hen." Discuss desirable characteristics. Hand this sheet to students and tell them how much of it you expect them to know.

3. Show "It Pays to Cull" and "Production of Caged Hens - Culled and Unculled." Make the point that culling pays - especially after 8 months of production.

4. Bring a layer of exceptional quality to class (or the shop.) Point out desirable qualities as indicated in B 1, 2, 3, and 4 in outline. Also use pages 2 - 5 in Culling Hens, Farmers Bulletin No. 2216 to help students understand desirable characteristics.
   Show a non layer and compare characteristics.

5. Point out how pigment can indicate how long a hen has been in production (or out of production). Illustrate with the two hens.

6. Point out the primary and secondary wing feathers and discuss molting. Emphasize:
   a. Birds go on vacation when they molt.
   b. Early molters often rest 6 months; late molters, 2 - 3 months

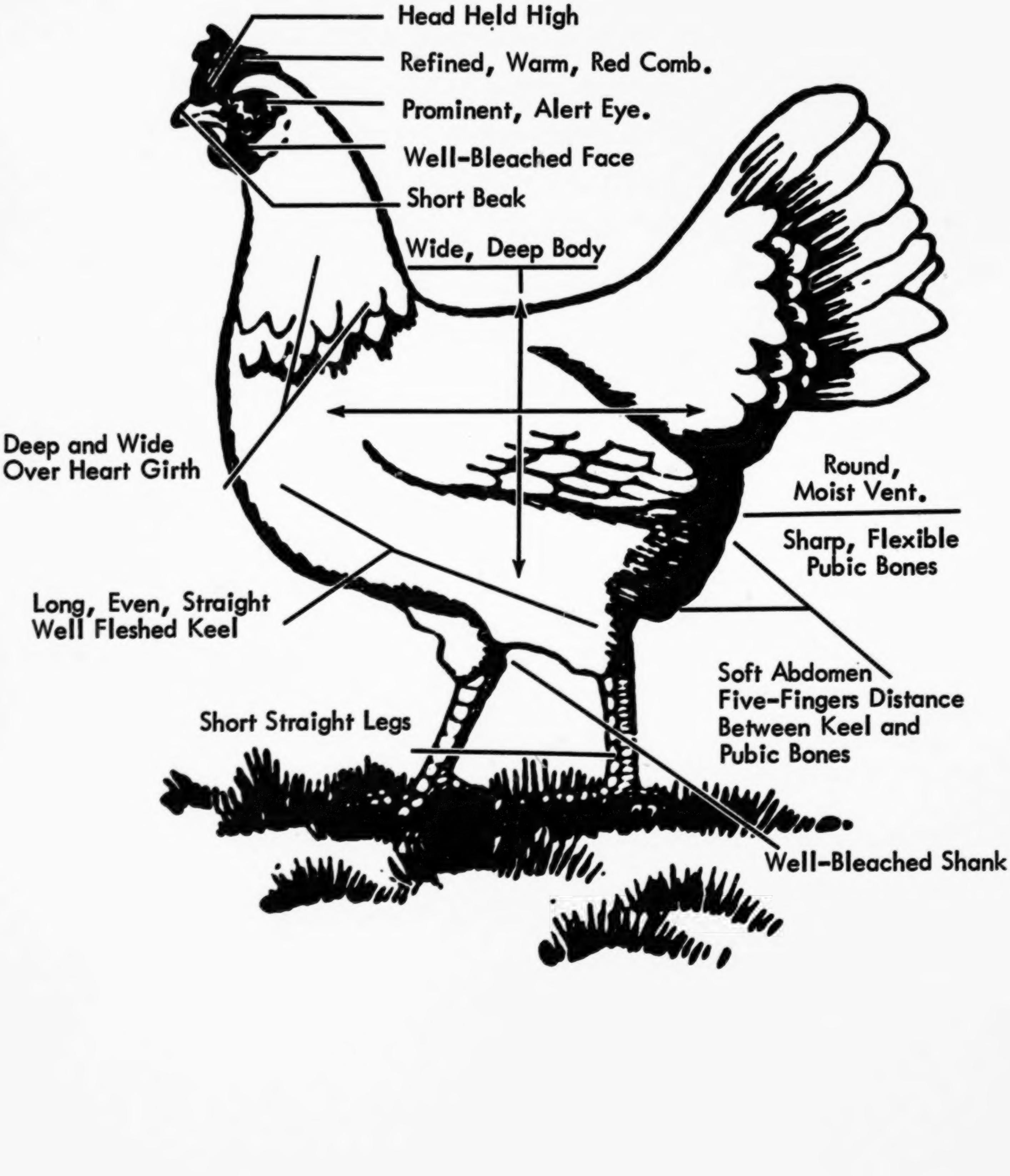
c. Chicks hatched too early in spring may go into a partial molt that fall. Ordinarily good hens will not molt until near the end of the first year of production.
d. Since it does not pay to keep hens a second year in Missouri, hens should be culled as soon as they start to molt.

7. Note characteristics of common breeds of chickens on page 564 of Livestock and Poultry Production. Emphasize that these breeds are used primarily in crosses, but they are the source for commercial varieties used on farms. Show pictures of the breeds. How can English, American, Mediterranean and Asiatic breeds be distinguished?

8. Show pictures of varieties of turkeys, ducks and geese. Discuss the importance of these along with broilers and roasters for meat. In general, what is the basis for selecting meat birds?

9. Discuss use of geese for weeding. (See MU Guide 8922.)

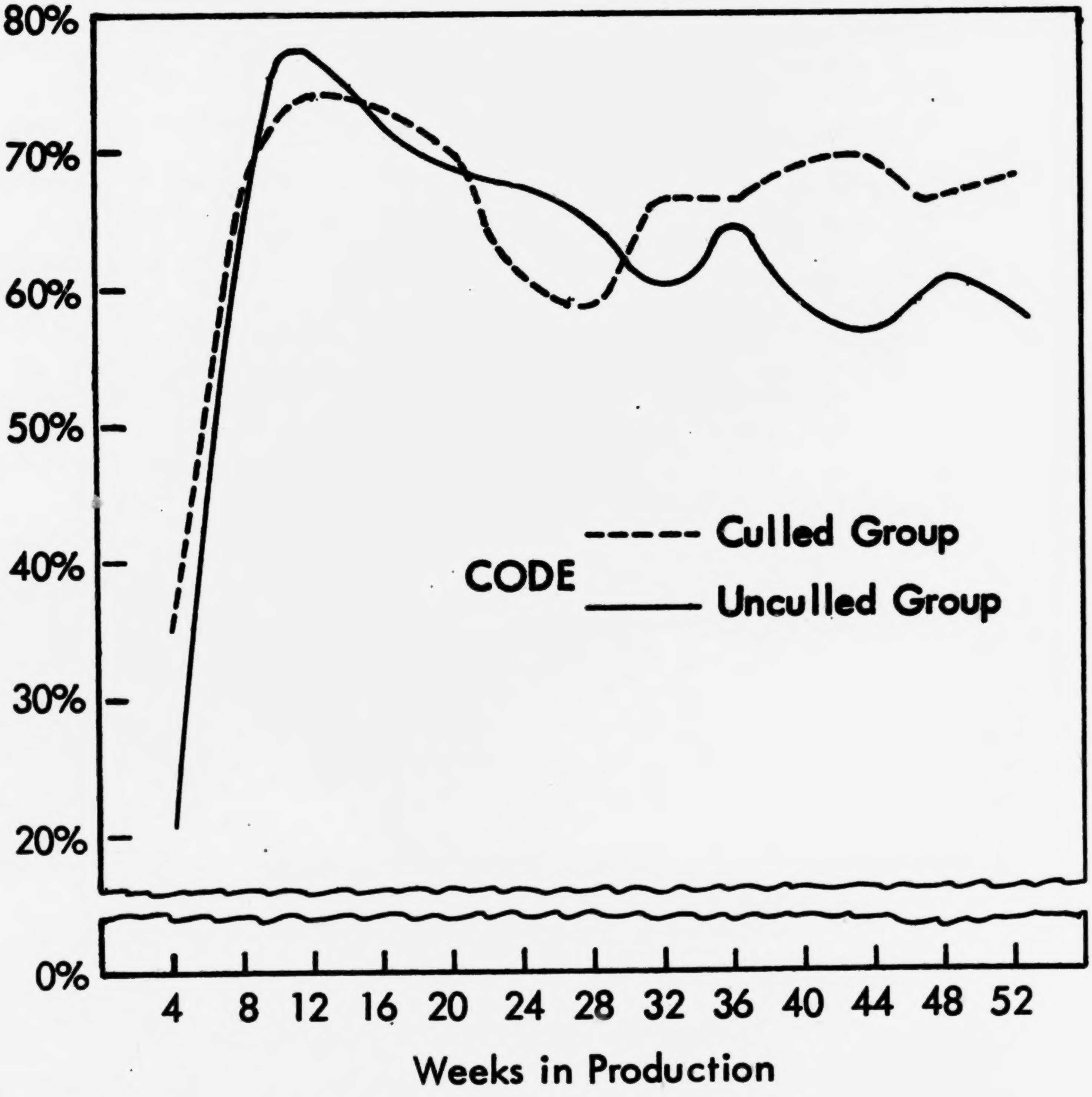
SUMMARY:


Head Held High
Refined, Warm, Red Comb.
Prominent, Alert Eye.
Well-Bleached Face
Short Beak
Wide, Deep Body
Deep and Wide Over Heart Girth
Round, Moist Vent.
Sharp, Flexible Pubic Bones
Long, Even, Straight Well Fleshed Keel
Soft Abdomen Five-Fingers Distance Between Keel and Pubic Bones
Short Straight Legs
Well-Bleached Shank

IT PAYS TO CULL

Pen No.	No. Birds	%Production before culling	% Culled	% Production after culling
148	316	46.8	15.0	54.2
149	278	48.6	9.4	54.9
151	288	51.7	5.2	54.2
152	293	45.4	13.3	55.1
153	313	41.0	23.0	54.1
	AVERAGE	46.6%	15.2%	54.6%

Production of Caged Hens
Culled and Unculled



Lesson 9. Selecting Other Classes of Livestock 3 days

OBJECTIVES:

1. To recognize desirable characteristics of classes of livestock raised in Missouri.
2. To be able to identify common breeds of livestock and recognize essential differences in their uses.

REFERENCES:

Beef: Animal Science, pages 441 - 445;
or Livestock and Poultry Production, pages 198 - 202

Sheep: Animal Science, pages 628 - 635
or Livestock and Poultry Production, pages 439 - 441

Hogs: Animal Science, pages 821 - 824
or Livestock and Poultry Production, pages 72 - 74

Dairy: Livestock and Poultry Production, pages 315 - 319

Horses: Animal Science, pages 1017 - 1026

Poultry: Livestock and Poultry Production, pages 570 - 573
or Culling Hens FB2216, pages 2 - 6

MOTIVATION:

We have made a detailed study of the selection of __________ and __________. If we are going to be good agriculturists it seems we should know something about most of the kinds of livestock on farms. If you were a producer of Shropshire sheep, what would you think of the agricultural salesman who congratulated you on your fine Hampshire ram? Have you known of persons being embarrassed by their lack of knowledge about breeds and classes of livestock? What other reasons can we think of which make it important for us to know about breeds and classes of livestock?

OUTLINE:

- A. Beef
  - 1. Major Parts of a Desirable Beef Animal
  - 2. Side View (Ideal)
    - a. Large, early maturing
    - b. Balanced and symmetrical
    - c. Great depth of body
    - d. Short coupled
    - e. Low-set
    - f. Straight top and bottom lines
    - g. Blocky
    - h. Deep, full quarters
    - i. A short, thick neck
    - j. Full, thick crops
    - k. Straight, true, and squarely set legs
    - l. Ample bone, with quality
    - m. Quality and smoothness
    - n. Style and breed type
  - 3. Rear View (Ideal)
    - a. Uniformly wide from front to rear
    - b. Wide over top
    - c. Trim in the middle
    - d. Level rump
    - e. Wide, deep, full quarters
    - f. Legs set wide apart
  - 4. Front View (Ideal)
    - a. Shapely head, short face, broad forehead, and wide muzzle
    - b. Femininity and masculinity
    - c. Wide, rounded, neat, and trim
    - d. Wide chest
    - e. Correctly set front legs
  - 5. Important Breed Characteristics

- B. Sheep
  - 1. Major Parts of a Desirable Sheep
  - 2. Side View (Ideal)
    - a. Large, early-maturing
    - b. Balanced and symmetrical
    - c. Great depth of body
    - d. Short coupled
    - e. Low-set
    - f. Strong, level back
    - g. Level rump
    - h. Trim underline

        - i. Blocky
        - j. Short, thick neck
        - k. Straight, true, squarely set legs
        - l. Strong pasterns
        - m. Ample bone
        - n. Style, pleasing and alert appearance
        - o. Breed type
        - p. Smooth bodied
    - 3. Rear View (Ideal)
        - a. Uniformly wide from front to rear
        - b. Wide over back and loin
        - c. Trim in the middle
        - d. Level rump
        - e. Deep, plump leg
        - f. Legs set wide apart
    - 4. Front View (Ideal)
        - a. Short, broad head
        - b. Femininity and masculinity
        - c. Wide, rounding, and moderately prominent brisket
        - d. Wide chest
        - e. Correctly set front legs
    - 5. Special Considerations with Sheep
        - a. Procedure in handling
        - b. Determining age
        - c. Overshot and undershot jaws
    - 6. Important Breed Characteristics

- C. Hogs
    - 1. Major Parts of a Desirable Hog
    - 2. Side View (Ideal)
        - a. Large, early maturing
        - b. Balanced and symmetrical
        - c. Adequate length
        - d. Adequate depth
        - e. Moderate, evenly arched back
        - f. High tail setting
        - g. Deep in flanks
        - h. Legs straight and squarely set, moderate length of leg
        - i. Strong pasterns
        - j. Trim underline and jowl
        - k. Smooth shoulders; free from wrinkles
        - l. Style
        - m. Twelve or more well-developed teats

3. Rear View (Ideal)
    a. Uniform width from front to rear
    b. Wide and full over loin
    c. Plump, full, trim, and firm ham; meated well down to hocks
    d. Legs set well apart
4. Front View (Ideal)
    a. Shapely and trim head
    b. True to breed characteristics
    c. Femininity and masculinity
    d. Correctly set front legs
5. Important Breed Characteristics

D. Horses
1. Major Considerations in Selection Based on Type
2. Side View (Ideal)
    a. High carriage of head, active ears, alert disposition, and beauty of conformation
    b. All parts well developed and nicely blended together
    c. Fairly long neck; carried high; clean-cut about the throat latch; with head well set on
    d. Sloping shoulders (about a 45° angle)
    e. A short, strong back and loin, with a long, nicely turned and heavily muscled croup, and a high, well-set tail; withers clearly defined and of the same height as the high point of croup.
    f. A short coupling as denoted by the last rib being close to the hip
    g. Ample middle due to long, well-sprung ribs
    h. Well let down in the rear flank
    i. Well-muscled arm, forearm, and gaskin
    j. Straight, true, and squarely set legs; pasterns sloping about 45°; hoofs large, dense, and wide at the heels
    k. Plenty of quality, as denoted by clean, flat bone, well-defined joints and tendons, refined head and ears, and fine skin and hair
    l. Showing plenty of breed type.
3. Rear View (Ideal)
    a. Wide and muscular over the croup and through the rear quarters
    b. Straight, true, and squarely set
4. Front View (Ideal)
    a. Head well proportioned to rest of body, refined, clean cut, with chiseled appearance; broad, full forehead with great width between the eyes; jaw broad and strongly muscled; ears medium sized, well carried and attractive

        - b. Refinement and femininity in the brood mare; boldness and masculinity in the stallion
        - c. A deep, wide chest
        - d. Straight, true, and squarely set
    - 5. Action
        - a. Walk - easy, prompt, balanced; a long step, with each foot carried forward in a straight line; feet lifted clear of the ground.
        - b. Trot - Rapid, straight, elastic trot, with the joints well flexed.
        - c. Canter - Slow, collected canter, which is readily executed on either lead
    - 6. Important Breed Characteristics

- E. Dairy
    - 1. Importance of high production
    - 2. Dairy Herd Improvement Associations
    - 3. Selection based on type
    - 4. Important breed characteristics

- F. Poultry
    - 1. Culling for Egg Production
        - a. Comb and Wattles
        - b. Brightness of Eye
        - c. Body capacity
        - d. Handling Quality
    - 2. Classes and Breeds of Poultry

PROCEDURES: Omit classes already studied in detail.

- A. Beef
    - 1. Show "Major Parts of a Beef Animal" and discuss the desirable characteristics. Why are these the qualities we want in beef cattle?
    - 2. Show the "Side View (Ideal)" and help students point out desirable characteristics.
    - 3. Show the "Rear View (Ideal)" and help students point out desirable characteristics.
    - 4. Show the "Front View (Ideal)" and help students point out desirable characteristics.
    - 5. Show pictures of popular breeds. Discuss distinguishing features of each. Hand out the sheet on breed characteristics and tell students how much of this you want them to learn.

B. Sheep
   1. Show the "Major Parts of a Desirable Sheep" and discuss the desirable characteristics.Why are these the qualities we want in sheep?
   2. Show the "Side View (Ideal)" and help students point out desirable characteristics.
   3. Show the "Rear View (Ideal)" and help students point out desirable characteristics.
   4. Show the "Front View (Ideal)" and help students point out desirable characteristics.
   5. Show and briefly discuss: "Procedure for Handling Sheep," "Determining Age by Teeth", "Overshot and Undershot Jaws."
   6. Show pictures of some common sheep breeds. Briefly discuss which breed is best, then hand out the sheet on breed characteristics. Tell students how much you expect them to learn.

C. Hogs
   1. Show "Major Parts of a Desirable Hog" and discuss the desirable characteristics. Why are these the qualities we want in hogs?
   2. Show the "Side View (Ideal)" and help students point out desirable characteristics.
   3. Show the "Rear View (Ideal)" and help students point out desirable characteristics.
   4. Show the "Front View (Ideal)" and help students point out desirable characteristics.
   5. Show pictures of popular breeds. Discuss distinguishing features of each. Hand out the sheet on breed characteristics and tell students how much of this you want them to learn.

D. Horses
   1. Show the picture of a desirable horse. Discuss some of the desirable characteristics. Why are these qualities desirable.
   2. Show the side view. Help students point out desirable characteristics.
   3. Show the rear view. Help students point out desirable characteristics.
   4. Show the front view. Help students point out desirable characteristics.
   5. Discuss the proper action of a horse at the walk, trot, and canter.

6. Show some pictures of popular breeds of horses. Discuss distinguishing features. Hand out the sheet on breed characteristics and tell students how much of this you want them to learn.

E. Dairy
  1. Discuss the importance of high milk production. Explain how the DHIA program can help farmers improve production in their herds.

  2. Distribute the Dairy Cow Unified Score Card. Discuss the major items and see whether students can understand why they are important.

  3. Show pictures of the popular breeds. Hand out the sheet on breed characteristics and tell students how much of this you want them to learn.

F. Poultry
  1. Show "Parts of a Hen." Discuss desirable characteristics. Why are these qualities desirable?
  2. Bring 2 hens to class and give a 15 minute demonstration on culling, so students will appreciate some of the qualities of good layers.
  3. Show pictures of breeds and classes of poultry. Distribute handout of popular breeds showing distinguishing characteristics. Tell students how much of this you want them to know.

SUMMARY:

Subunit: Animal Breeding 9 days

OBJECTIVES:

1. To develop a beginning understanding of the physiology of reproduction among farm animals.
2. To understand some simple principles of genetics.
3. To learn how livestock breeders use genetic principles in improving livestock.

MOTIVATION:

Fascinating, indeed, is our increasing understanding of how to improve livestock. Many of you realize how important hybrid corn has been in increasing corn yields. Research activities of livestock breeders have also been quite influential in increasing livestock production. And most important perhaps, the future of such activity for one of you who would like this kind of work seems unlimited.

LESSONS:	Days	Page
1. How Animals Reproduce	4	127
2. How Traits are Inherited	3	139
3. Improving a Swine Herd Genetically	2	151
	9	

GETTING READY FOR THIS SUB UNIT:

References and Materials
1. Introduction to Breeding Farm Animals
2. "Reproduction of Farm Animals" Cornell Bulletin 305
3. MU Guide 2908 "Livestock Breeding Pointers"
4. Handouts:
    "Animal Reproduction"
    "How Inheritance Works"
    Heritability of Traits"
    "Improving a Swine Herd"
        Alternate: "Improving Beef Herds"
5. Slides (AS65) Iowa State University, set of color slides

6. Movies

Source: Communications Department
119 Whitten Hall
Columbia, Missouri

	Minutes
"Reproduction Among Mammals"	10
"Heredity"	10
"Improving Strains of Livestock"	13

EVALUATION:

1. Give an objective test over the sub unit.

2. See if students are able to use knowledge gained in the last sub unit and with their farming programs.

Lesson 1. How Animals Reproduce 4 days

OBJECTIVES:

1. To understand the process of reproduction among animals.
2. To be able to identify the parts of the male and female reproductive system and to understand the principal functions of these parts.

REFERENCES:

Introduction to Breeding Farm Animals

Improving Animals Is Through Breeding--Scrambled Book

Reproduction of Farm Animals

MU Guide 2908 "Livestock Breeding Pointers"

		Page
Handout:	"Animal Reproduction"	131
AS 65 Slides 56 to 66		
Transparencies:	"Reproductive Organs of a Bull"	135
	"Reproductive Organs of a Bull"(unlabeled)	136
	"Reproductive Organs of a Cow"	137
	"Reproductive Organs of a Cow"(unlabeled)	138

MOTIVATION:

Show the movie, "Reproduction Among Mammals." How can our understanding of the reproductive process help us be better producers of livestock? Who else besides farmers can benefit from a knowledge of reproduction of farm animals?

OUTLINE:

A. Parts and Functions of Male
   1. Epididymis: to store and mature sperm
   2. Penis: to deposit semen in the female system
   3. Sigmoid flexure: to extend the penis
   4. Retractor muscle: to retract the penis
   5. Vas deferens: to provide a passageway for sperm
   6. Scrotum: to support and provide thermal control for the testis
   7. Testis: to produce sperm and male hormone

8. Cowpers gland: to add fluid to the sperm
9. Prostate gland: to counteract the toxic effect of unine

B. Parts and Functions of Female
   1. Infundibulum: to catch egg
   2. Ovaries: to produce eggs and female hormones
   3. Uterus: to house the new individual
   4. Vagina: the organ of mating and birth canal
   5. Vulva: the terminal organ of uninary and genital systems
   6. Cervis: helps form vaginal plug
   7. Fallopian tubes: a place of fertilization and a passageway
   8. Clitoris: controls glands in wall of vulva

C. Hormones--Types and Functions
   1. Follicle Stimulating Hormone (FSH): causes the Graafin follicle to grow which produces estrogen. FSH is produced by the pituitary gland.
   2. Luterinizing Hormone (LH): causes ovulation, growth of corpus luteum, and produces progesterone. LH is produced by the pituitary gland.
   3. Progesterone: causes decrease in LH production and increases in FSH. Progesterone is produced by the corpus luteum. Progesterone complements the work started by estrogen for the implantation of the embryo.

   4. Estrogen: causes decrease in FSH production and an increase in LH production. Estrogen is produced by the graafin follicle. Estrogen induces heat and prepares the uterus for the reception of the fertilized egg. Estrogen causes sex drive in females.
   5. Androgen: male hormone produced by the testis. This hormone produces sperm, causes sex drive, and develops secondary sex characteristics.

PROCEDURES:

1. Assign one or more of the following:
   Introduction to Breeding Farm Animals, Pages 27 - 32
   Reproduction of Farm Animals, Pages 3 - 5
   "Animal Reproduction," Male Reproductive Organs

2. Show "Reproductive Organs of a Bull." Hand out the labeled copy. Discuss the functions of each part permitting students to take notes.

What are the testes?
Why are testes carried outside the body cavity?
What is the function of the vas deferens?
What is the purpose of the prostrate gland?
What is the composition of semen?

4. Hand out unlabeled "Reproductive Organs of a Bull" and give a review test. Show the labeled transparency again to straighten out misunderstandings.

5. Trace the path of sperm through the system. Show where substances are added to form semen.

6. Assign one or more of the following:
Introduction to Breeding Farm Animals, pages 32 - 35
Reproduction of Farm Animals, pages 5 - 6
"Animal Reproduction," Female Reproductive Organs

7. Show "Reproductive Organs of a Cow." Hand out the labeled copy. Discuss the function of each part.

8. Hand out the unlabeled "Reproductive Organs of a Cow" and give a review test. Show the transparency again to straighten out misunderstandings.

9. Trace the path of the egg and sperm to fertilization and implantation.

10. Show slides to help illustrate what has been learned.

11. Assign one or more of the following:
Introduction to Breeding Farm Animals, pages 38 - 44
Reproduction of Farm Animals, pages 7 - 10
"Animal Reproduction," Fertilization and Pregnancy and Birth.

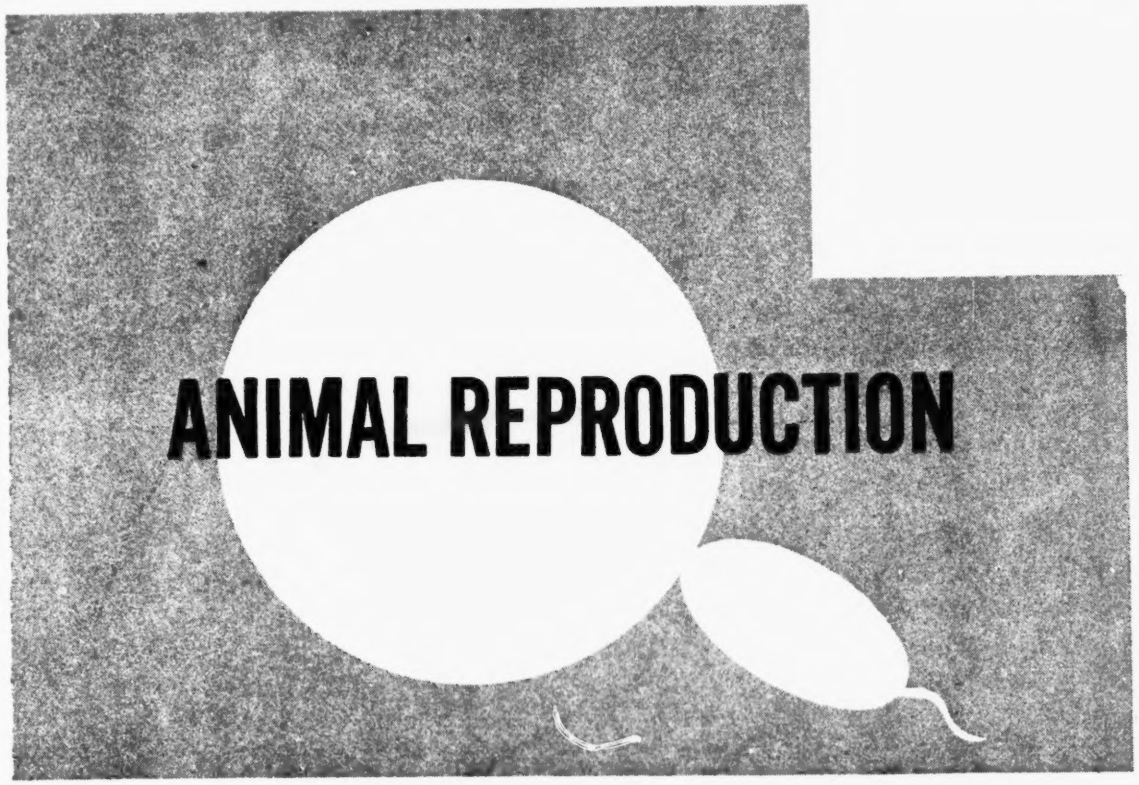
12. Explain gestation, puberty and estrus and how hormones control these.

13. Hand out MU Guide 2908. Discuss Tables I, II and III. Let students practice on problems such as: When would a cow clave if bred today? When will an animal come back in heat if she did not conceive when bred today? When should animals born today be bred the first time for satisfactory results?

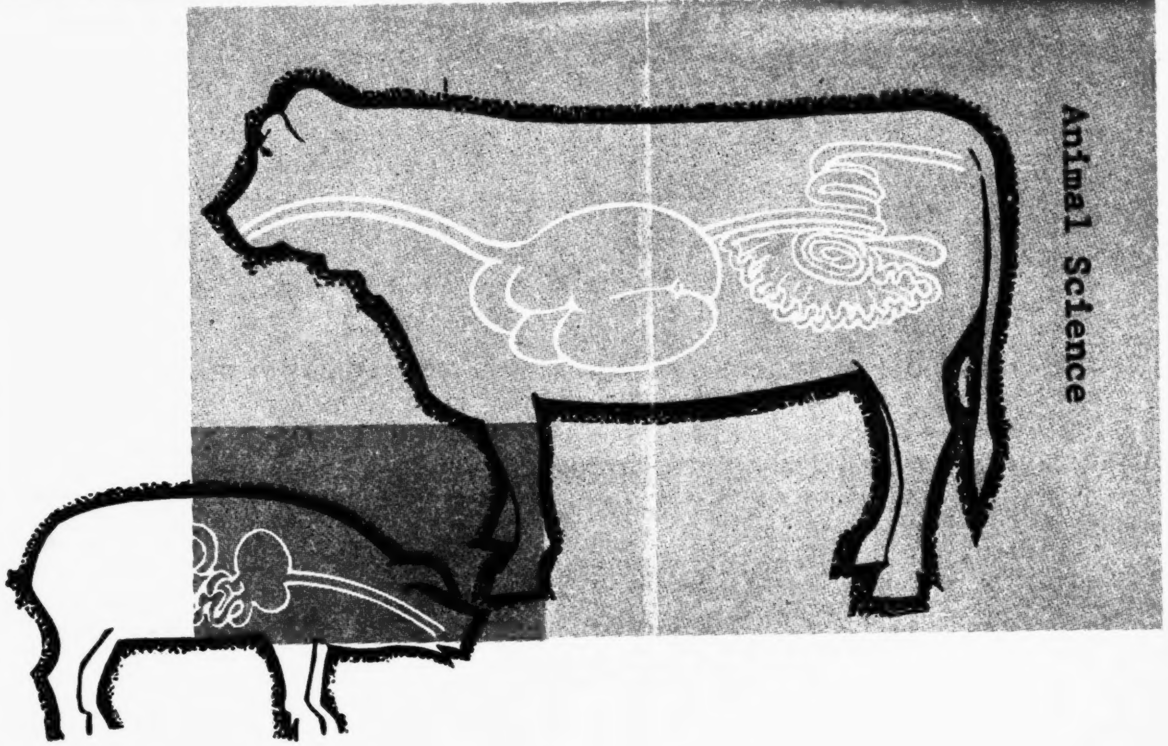
14. Use the following questions as a review test. Discuss them to emphasize application of what has been learned.

a. Why do male animals look different from females?
b. Why are the testes carried outside the body cavity?
c. What is the effect of castration on male animals?
d. Why do we castrate most of the male animals?
e. Why is artificial insemination used extensively in dairy cattle but not in beef cattle, sheep or swine?
f. Why do normal female animals come in heat at regular intervals?
g. Why is it recommended that insemination take place toward the end of the heat period?'
h. Why are billions of sperm needed when only one actually fertilized the egg?
i. Why do you suppose there are two testes and two horns of the uterus?
j. Why are most twin heifers that are born with a bull calf infertile upon reaching sexual maturity?

SUMMARY:



ANIMAL REPRODUCTION



The birth of an animal is the end of a wondrous process. It starts with the merging of two tiny cells—one from the female animal, one from the male. With the joining of these cells, a new animal is conceived.

The cell from the female is called an egg, or ovum. The cell from the male is a sperm. The egg and sperm are both sex cells, the very special cells that contain the genetic material an animal inherits from its parents. Two microscopic cells will completely determine the genetic makeup of the offspring.

The production of sex cells is a unique and interesting process. Each of the two sexes has special organs to produce sex cells and carry out the process of reproduction. These are called the reproductive organs.

Male Reproductive Organs

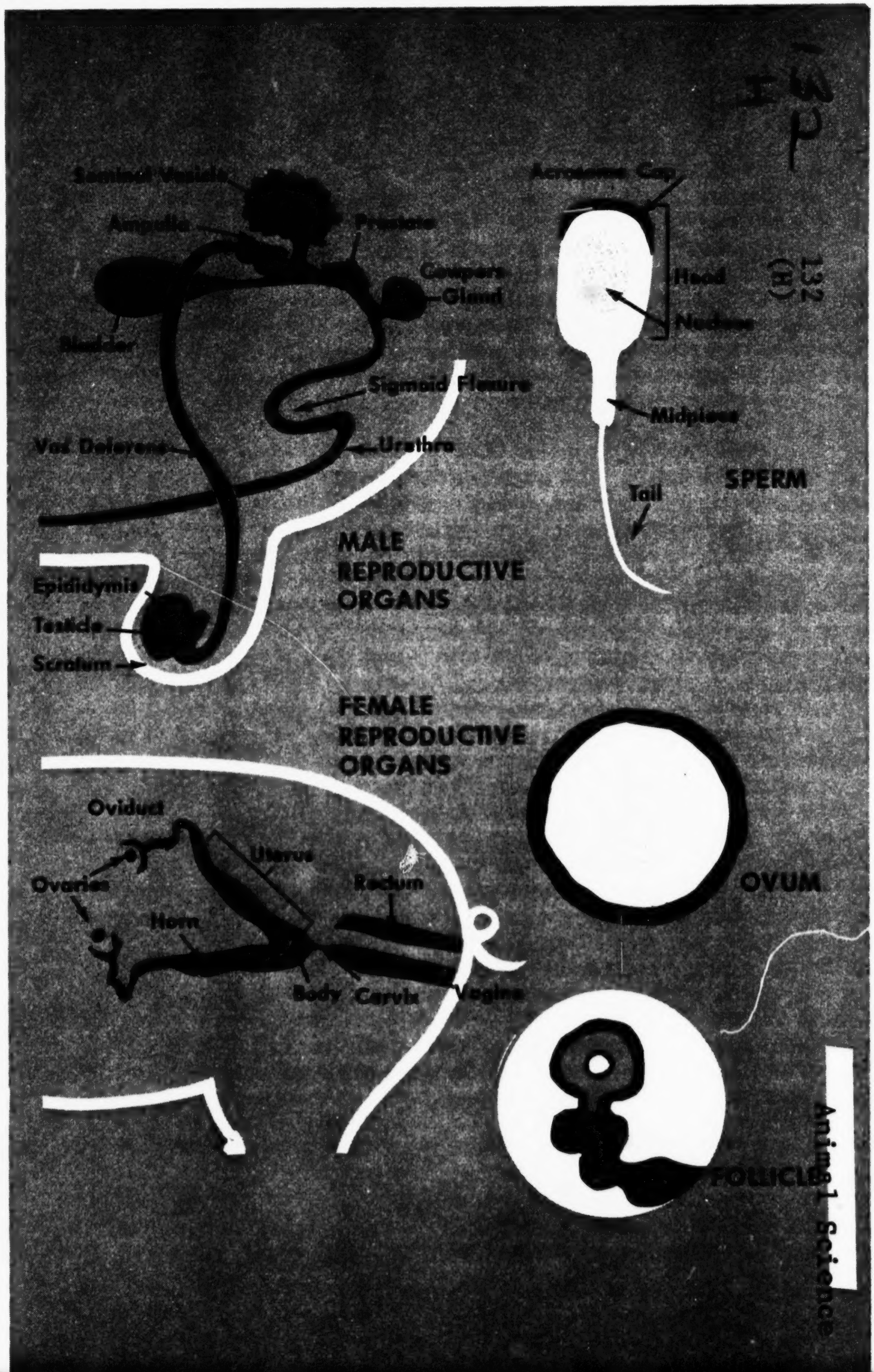
- In the male, the two *testicles* are the organs that produce sperm. They also produce a hormone called testosterone. Hormones are chemical compounds that are released into the blood stream (secreted) by glands. They help regulate body functions. Testosterone is the hormone that causes changes in males as they mature. The uneven temper and massive forequarter of a bull are caused by this hormone. A boar's heavy tusk and strong odor are also due to testosterone.
- Each testicle is a mass of tiny tubes. The inner walls of these tubes produce sperm. The thousands of tubes merge at the front edge of the testicle. There, they form a series of larger, tightly coiled tubes where the sperm collect. These make up the *epididymis.* Its function is to store sperm while they mature.
- The testicles and epididymides are held in the scrotum, the sac-like pouch suspending them from the body. They are outside the body because the testicles must be kept cooler than body temperature to function properly. The scrotum helps regulate their temperature. It relaxes in hot weather, moving the testicles away from the body. In cold weather, it contracts.

Source: Dr. T. W. Wickersham, Extension Animal Scientist, Iowa State University

- From the epididymis, the sperm move through a tube, the *vas deferens*, into the *urethra*. The urethra is the tube that carries urine from the bladder through the penis. The urethra also carries sperm from the junction with the vas deferens to the end of the penis.
- Along the urethra are the *accessory glands.* Their names are the *prostate,* the *seminal vesicles* and *cowpers gland.* They produce fluids that nourish and preserve the sperm. During mating, the accessory glands discharge their fluids into the urethra. This washes the sperm forward through the penis. The combined fluid and sperm is called *semen.*

Female Reproductive Organs

- Female reproductive organs are quite different from the male's. The female must not only produce sex cells, she must also provide a place for the unborn animal to develop.
- The main female organs are the two *ovaries* and *oviducts,* the *uterus,* the *cervix* and the *vagina.*
- The ovaries produce the eggs. Each egg is contained in a tiny bubble on an ovary. This bubble is called a follicle. It is about the size of a pinhead. There are hundreds of follicles on each ovary.
- By a process not yet understood, one or more follicles begin to grow while the others remain small. The follicle grows until it is about the size of a pencil eraser. It is filled with a fluid. The egg is suspended in the fluid. Near the time of mating, a hormone causes the follicle to burst.
- The fluid gushes out of the follicle, carrying the egg with it. The egg is then trapped in a very thin membrane that surrounds the ovary. Shaped like a funnel, this membrane is called the *infundibulum.* The infundibulum narrows into a tube called the *oviduct.* Each oviduct is about the diameter of a wooden match. Its length varies from a few inches to over a foot, depending on the kind of animal.
- The oviduct carries the egg to the *uterus,* or womb. The largest of the female reproductive organs, the uterus is where the unborn young (the *fetus*) will develop.
- The uterus has a thick wall with heavy layers of muscles. At birth, these muscles will contract with great pressure to force the new animal through the *cervix* and *vagina* (birth canal) and into the world. The lining of the uterus is soft and spongy, containing a vast network of blood vessels. This network of blood vessels provides a "bed" for the fertilized egg to settle into and develop.
- How this egg is fertilized is the next part of the reproduction story.


Seminal Vesicle
Ampulla
Prostate
Cowpers Gland
Bladder
Sigmoid Flexure
Vas Deferens
Urethra
Epididymis
Testicle
Scrotum
MALE REPRODUCTIVE ORGANS
Acrosome Cap
Head
Nucleus
Midpiece
Tail
SPERM
FEMALE REPRODUCTIVE ORGANS
Oviduct
Ovaries
Uterus
Horn
Rectum
Body
Cervix
Vagina
OVUM
FOLLICLE

Fertilization

- When a gilt or heifer is old enough to be bred, it begins to have *estrus periods.* (These are also called "heat" periods.) In cattle, one egg is usually released from one ovary during each estrus period. In swine, several eggs are released by each ovary at each estrus period. The release of the egg or eggs is called ovulation.

- Meanwhile, in the male animal, sperm is continuously produced in enormous numbers. During mating, the bull deposits semen in the vagina of the cow or heifer. With swine, semen is deposited in the cervix of the female.

- Mating apparently stimulates the female's uterus to contract and relax several times a minute. This pulsing action forces the sperm through the uterus, into the oviducts and the infundibulum. Here, the sperm and egg unite. This is fertilization.

- Only one sperm is needed to fertilize each egg. A great many sperm are present, however. A boar, for example, usually deposits about 50 billion sperm at a mating. This large number assures that at least one live sperm will reach every egg.

- In swine there are several eggs to be fertilized. Each fertilized egg will become one of the pigs of a litter. In cattle, only one egg is usually present. Sometimes a cow will produce two eggs. If both are fertilized, the cow will have twin calves. These two calves would not look alike, however. Each twin would develop from a separate egg and sperm. Identical twins result from a different situation, when a single fertilized egg divides into two at a very early stage.

- When examined under a microscope, an egg resembles a chicken egg without a shell. It has a clear fluid on the outside covered by a thin membrane. In the center, there is a dark mass similar to an egg yolk. This center is the *nucleus.* It is the part of the egg that contains the genetic material.

- The sperm has a much different shape. It is much smaller than the egg and is shaped something like a tadpole. It has a head, a middle section and a tail. The genetic material is contained in the head.

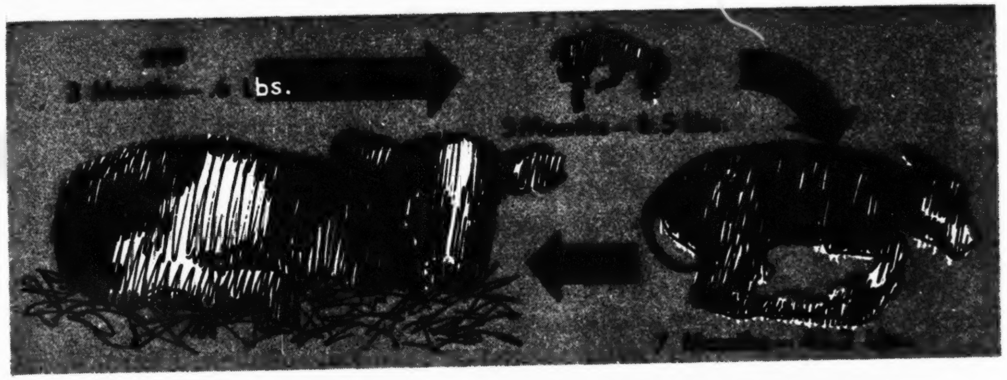
- At fertilization, a sperm penetrates the outside membrane of the egg and is drawn into the nucleus. At this time, when the sperm enters the nucleus, the complete genetic makeup of the offspring is determined.

- The fertilized egg then passes from the infundibulum into the oviduct and finally into the uterus. The soft, spongy lining of the uterus traps the fertilized egg at some suitable spot. There, the microscopic fertilized egg will grow into a new animal. (In cattle, of course, there is usually only one new animal developing. In swine, several eggs develop simultaneously at different spots along the uterus.)

- Meanwhile, in the empty follicle from which the egg has come, a change begins. The cells lining the follicle change form and multiply very rapidly. Soon there is a solid mass about the size of a grape where the follicle once was. This is called the *corpus luteum.* It produces a hormone called *progesterone* which prevents other follicles from developing. As long as the fetus is in the uterus, progesterone will be produced.

- This is important because it keeps the uterus in perfect condition for the developing fetus. Since no more follicles mature, the mother animal cannot become pregnant again until the fetus is born.

- If the egg is not fertilized, the corpus luteum will begin to shrink in about 2 weeks. It will disappear by the end of the third week. The female will then be able to produce another egg and show another estrus. This cycle repeats itself about every 21 days in cattle and swine until the animal becomes pregnant.



Pregnancy and Birth

- Pregnancy is the time during which the fetus develops in the uterus. In order for the fetus to develop, a new membrane must form on the uterine wall. A network of membrane and tiny blood vessels begins to take shape shortly after the fetus becomes located in the uterus. This membrane become the *placenta.* Through it, the unborn animal is nourished.

- From the mother's blood stream, nutrients and oxygen pass through the uterus, into the placenta and into the fetus. Waste products from the fetus pass into the placenta, through the wall of the uterus and back into the mother's blood stream. (After the animal's birth, the placenta is expelled from the uterus. This is the "afterbirth.")

- Linking the fetus to the placenta is the navel cord, which connects to the fetus' abdomen. Two large blood vessels run through the navel cord. One carries nutrients and oxygen from the placenta to the uterus. The other carries waste chemicals from the fetus to the placenta.
- The fetus develops gradually. Most of its growth comes in the last one-third of pregnancy. However, most of the vital organs are formed early. The head, nervous system and blood system develop first. Later, the bones and limbs are formed.
- At the proper time, the strong muscles of the uterus contract, forcing the new animal through the birth canal and into the world.
- Until now, the young animal received nutrients and oxygen from its mother's blood stream. But at birth the navel cord is broken. The animal must live on its own. Apparently the breaking of the navel cord stimulates the animal to breathe. This solves the problem of oxygen. As for nutrients, the mother's body has been preparing them for many weeks. The hormones produced during pregnancy have stimulated the milk glands. By the time of birth, they are ready to provide milk.
- The first milk produced is called colostrum. It is very rich in vitamins and certain minerals the newborn calf or pig needs for a good start. For the first 12 to 24 hours it is essential for the new animal to receive colostrum. Then, gradually, the production of colostrum gives way to regular milk.
- By the end of a week, the new animal has made the major adjustments to its new environment. From here on, the welfare of the young animal is mostly up to its owner. But nature has given the animal a wonderful beginning in an amazing series of processes.

GLOSSARY

ACCESSORY GLANDS (ak-sés-ō-ri). These glands are located along the urethra of the male. They produce fluids that nourish and preserve sperm.

BIRTH CANAL The birth canal includes the cervix and the vagina of the female. They are the organs through which the unborn animal passes at birth.

CERVIX (sur´ viks). This is the narrow passage or doorway between the female's vagina and uterus.

CORPUS LUTEUM (kor´ pus lū´ te-um). A solid mass that forms in the follicle after the egg has left. It produces a hormone which helps maintain pregnancy. It prevents other follicles from developing while the unborn animal is growing in the uterus.

EPIDIDYMIS (ep´ĭ-did´ĭ-mis). A mass of tubes connected to the testicle. Its main function is to store sperm.

ESTRUS (es trus). The estrus period is commonly called "heat."

FETUS (fē´ tus). The unborn animal as it develops in the uterus.

FOLLICLE (fol´ĭ-k' l). A bubble-like structure on the ovary which contains an egg.

HORMONE (hor´mon). A body-regulating chemical secreted by a gland into the blood stream.

INFUNDIBULUM (in´ fun-dib´ u-lum). The funnel-like membrane that surrounds the ovary. It catches the egg when it is released by the ovary.

NUCLEUS (nu´kle-us). The dense center of a cell. It contains the genetic material.

OVARY (o´ va-ri). A female organ that produces eggs. There are two ovaries.

OVIDUCT (o´ vĭ-dukt). The tube which carries the egg from the ovary to the uterus.

OVULATION (o´ vu-la´ shun). The time when the follicle bursts and the egg is released.

OVUM (o´ vum). Scientific name for egg.

PLACENTA (plă-sen´ tă). The membrane by which the fetus is attached to the uterus. Nutrients from the mother pass into the placenta and then through the navel cord to the fetus. When the animal is born, the placenta is expelled. It is commonly called the "afterbirth."

SEX CELLS The egg and the sperm. They transmit genetic material from the parents to the offspring.

SCROTUM (skro´ tum). The sac-like pouch that suspends the testicles outside the male animal.

SPERM Male sex cells produced in the testicles.

SEMEN (sē´ men). Sperm mixed with fluids from the accessory glands.

TESTICLE (tes´ ti-k' l). A male gland which produces sperm. There are two testicles.

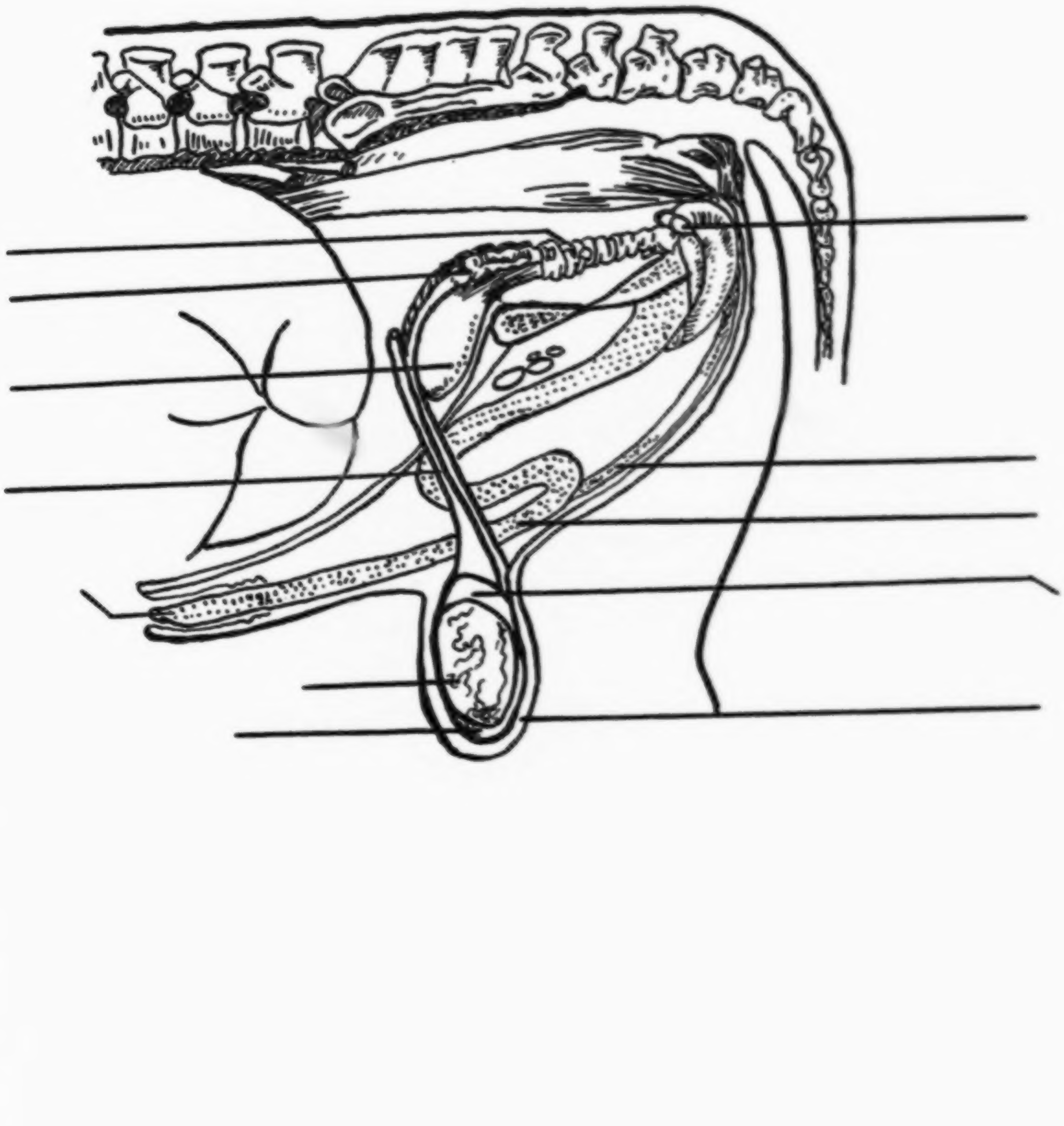
URETHRA (u-rē´ thra). The tube through which both semen and urine pass through the penis of the male.

UTERUS (u´ ter-us). The muscular, spongy organ of the female where the unborn animal develops. It is commonly called the womb.

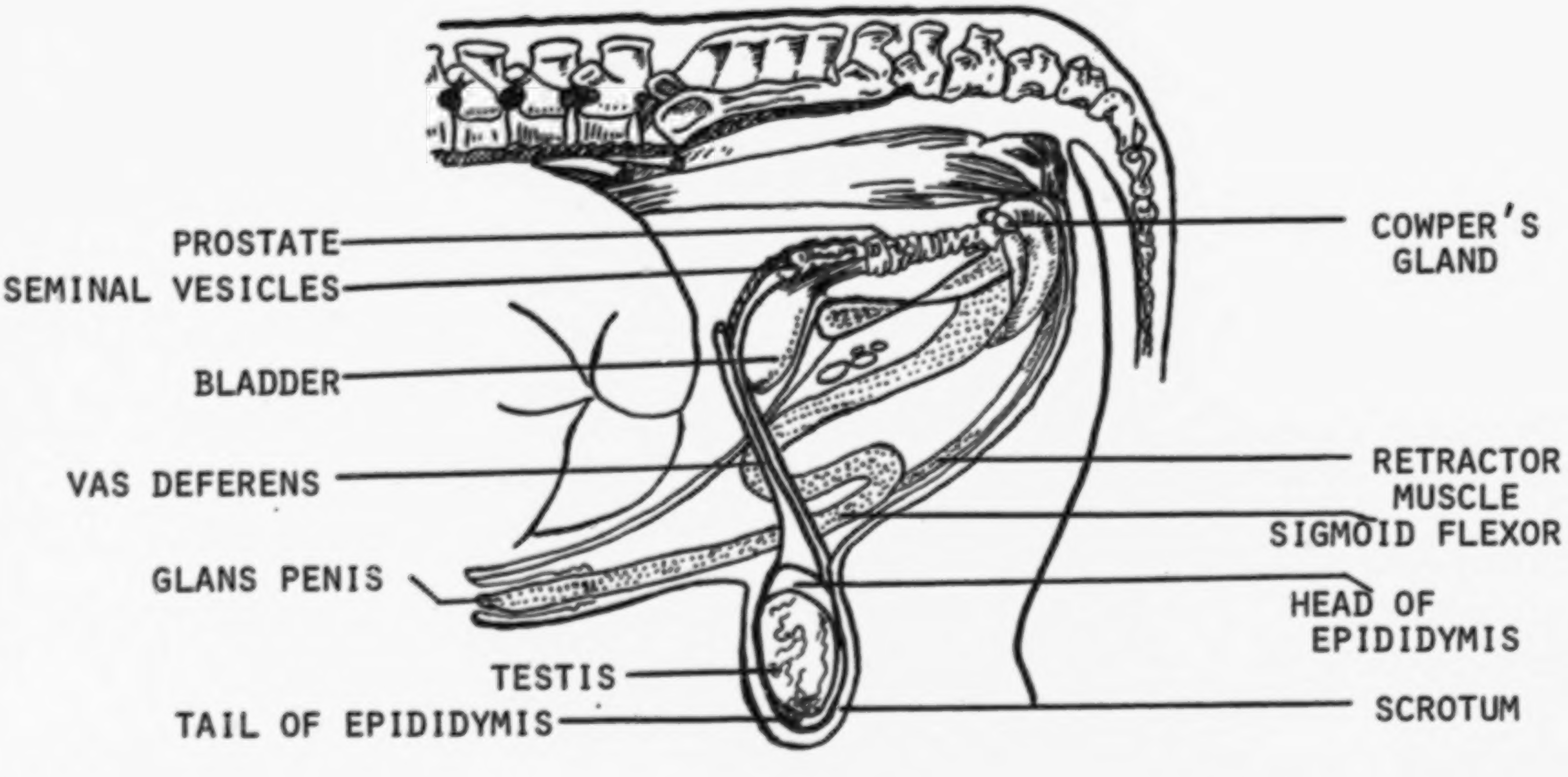
VAGINA (va-ji´ na). The canal which leads from the uterus to outside the female. Sperm is deposited there by the male, and the fetus passes through the vagina at birth.

VAS DEFERENS (văs def´ĕ-renz). The tube that carries sperm from the epididymis to the urethra in the male.

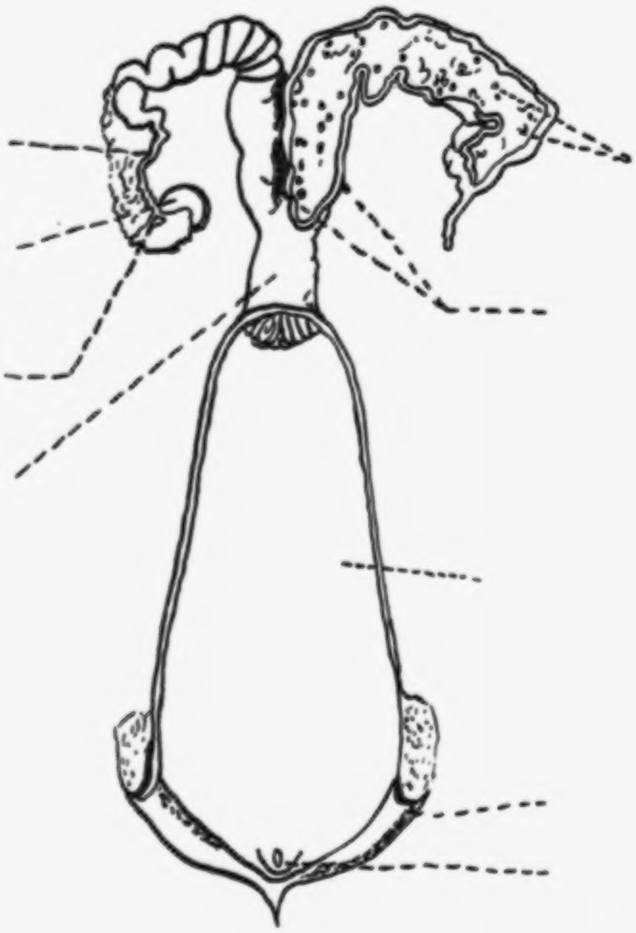
REPRODUCTIVE ORGANS OF A BULL



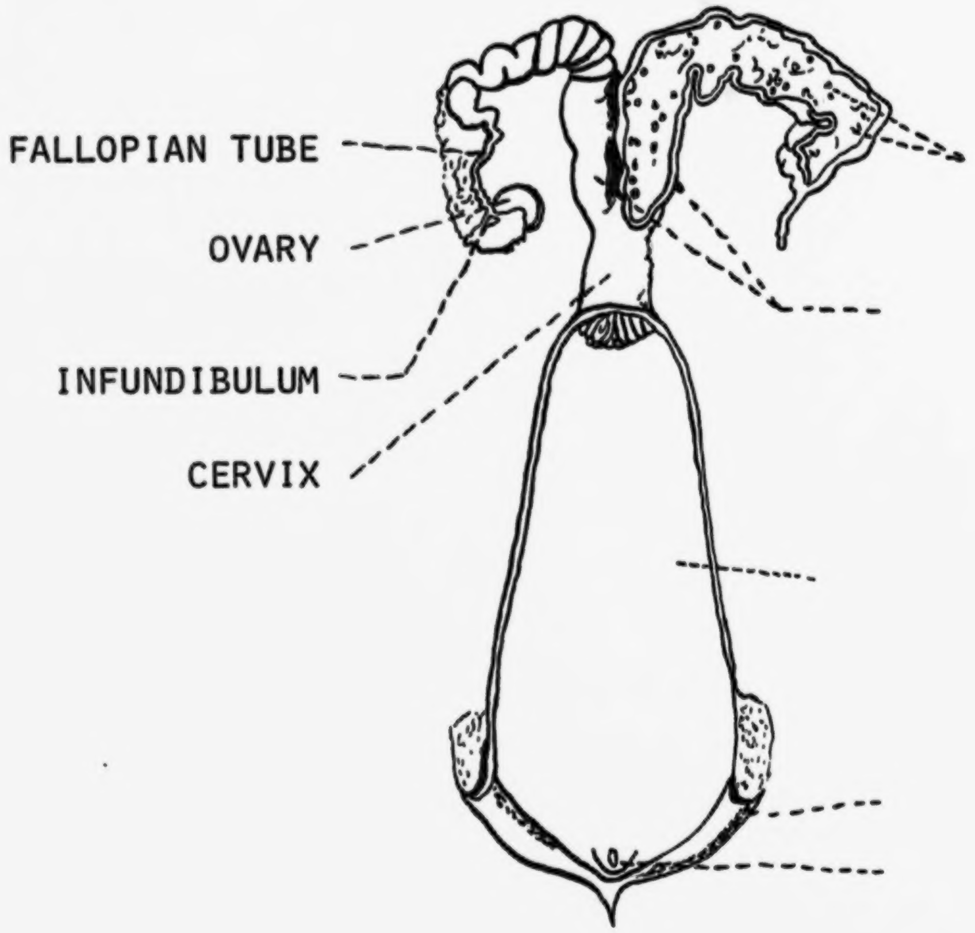
REPRODUCTIVE ORGANS OF A BULL


PROSTATE
SEMINAL VESICLES
BLADDER
VAS DEFERENS
GLANS PENIS
TESTIS
TAIL OF EPIDIDYMIS
COWPER'S GLAND
RETRACTOR MUSCLE
SIGMOID FLEXOR
HEAD OF EPIDIDYMIS
SCROTUM

REPRODUCTIVE ORGANS OF A COW



REPRODUCTIVE ORGANS OF A COW


FALLOPIAN TUBE
OVARY
INFUNDIBULUM
CERVIX

Lesson 2. How Traits are Inherited 3 days

OBJECTIVES:

1. To understand how an animal's characteristics are influenced by its genetic makeup.

2. To be able to use the process of meiosis in explaining the genetic makeup of an animal.

3. To understand variations in heritability of traits and how producers try to improve performance of their livestock.

REFERENCES:

Livestock and Poultry Production, pages 667 - 670

Introduction to Breeding Farm Animals, pages 45 - 52; 57 - 58

		Page
Handouts:	"How Inheritance Works"	142
	"Heritability of Traits"	146

As 65 Slides, 67 - 75

MOTIVATION:

Why are Herefords red and white; Angus black; Shorthorns red, white or roan?

OUTLINE:

A. Genes and Chromosomes
   1. Heritable characteristics are determined by genes carried on chromosomes that appear in every living cell.
   2. Every cell in an individual is identical in its chromosome and genetic composition except for germ cells.

   3. Germ cells (reproductive cells) contain only one of each pair of chromosomes.

   4. When fertilization occurs, chromosomes are again restored to pairs.

B. Dominance
   1. The gene for polled, P, is dominant to the gene for horned, p, in cattle.
   2. Offspring of polled animals will not necessarily be polled if both parents have a genotype of Pp.
   3. Mathematical probabilities can be derived regarding the phenotype of offspring if the genotype of parents is known.
   4. Male mammals contain an unmatched pair of chromosomes which determine the sex of offspring.
   5. Some genes are not clearly dominant or recessive--Shorthorns: red, roan, white.

C. Heritability of Traits
   1. Unlike horns on cattle, many important characteristics are determined by hundreds of genes on many pairs of chromosomes--conformation, rate of gain, meatiness etc.
   2. The relative importance of heredity and enviornment is a long-standing issue.
   3. Scientists have estimated the heritability of certain important traits based upon their efforts to improve livestock.
   4. From these heritability estimates, one can predict the amount of improvement to be expected from selecting improved breeding stock.

PROCEDURES:

1. Show the movie "Heredity".

2. Show and discuss "Normal Cell Division" (Slide 67).

3. Show and discuss "Reduction Division" (Slide 68). Point out the restoration of chromosome pairs at fertilization. Where are these cells developed?

4. Show "Mating of Polled Cow and Horned Bull" (Slide 69). How would the offspring appear? Be sure students understand "dominant" and "recessive."

5. Show "Mating of Cow with Recessive Genes for Horns and Horned Bull" (Slide 70). Discuss.

6. Show "Mating of Polled Cow (Pp) and Polled Bull (Pp) (Slide 71). See that students understand why offspring will appear as they do.

7. Explain the dominance of black over red in cattle. Have students work out their own charts on offspring from various matings.

8. Show "How Sex is Determined" (Slide 72). Help students understand that sex is determined by the male. What would happen if a characteristic (baldness in men) were carried on the sex chromosome?

9. Discuss the inheritance of such characters as conformation, rate of gain, meatiness, and feed efficiency. (Show Slide 73). How many traits are involved in each one? How can we hope to improve livestock when inheritance of important characteristics is so complicated?

10. Discuss imcomplete dominance. (Shorthorn cattle)

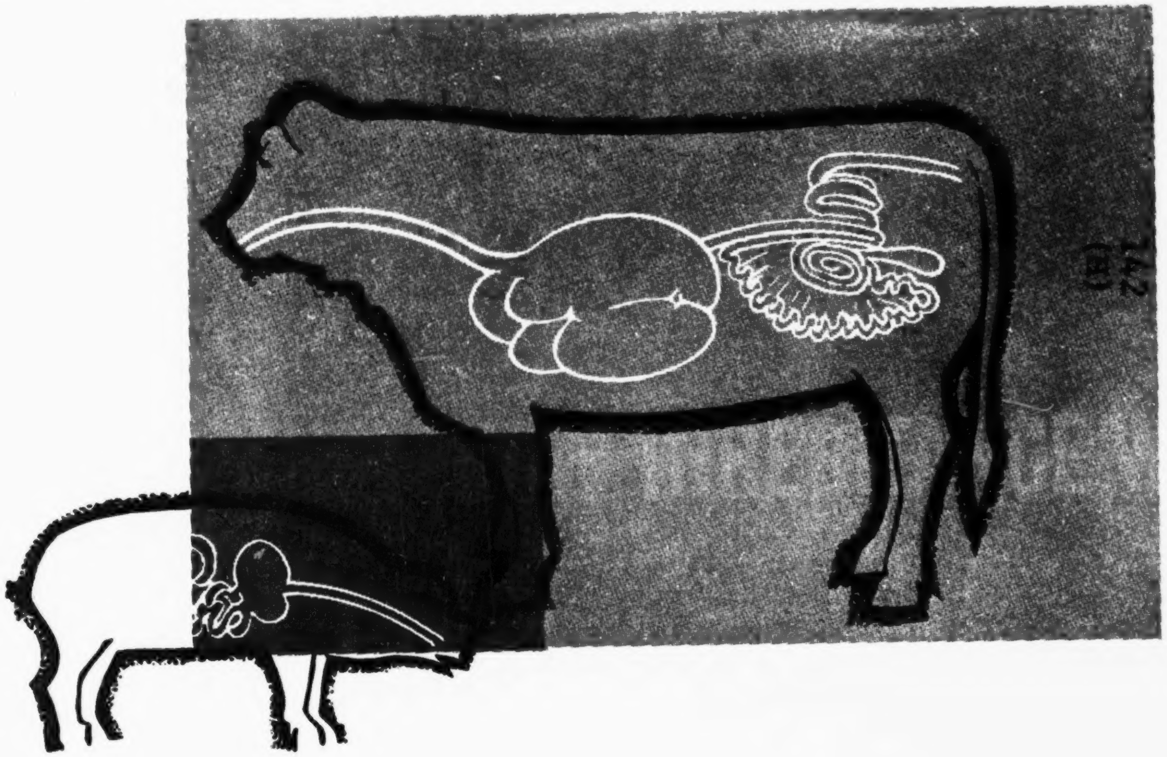
11. Show "Heredity, Environment." (Slide 74)

12. Show "Per Cent Heritability of Traits in Hogs and Beef Cattle." (Slide 75.) Which traits should breeders pay particular attention to?

13. Discuss information from "Heritability of Traits" to emphasize practical applications of heritability theory. Work through the two illustrations with the class.

SUMMARY:

HOW INHERITANCE WORKS



Two tiny cells are the only links an animal has with its parents. A sperm cell from the sire, an egg cell from the dam—these grow into the new animal.

We know, therefore, that whatever characteristics are inherited from the parents must come from these two cells. Assuming that good care and nutrition is provided, the material in the sperm and egg will determine almost everything about the developing animal—its size, its shape, color, even its intelligence.

The study of how characteristics are passed from parents to offspring is the science of genetics. It's easy to see why genetics is important to livestock producers. In trying to understand the mysteries of inheritance, geneticists learn things which are helping to produce better livestock.

Genes and Chromosomes

Inside the cells of animals are certain complex chemical compounds. Geneticists are fairly certain that they are the carriers of inheritance. They are called *genes* and *chromosomes.*

Chromosomes are long, thread-like structures, apparently made of protein, large enough to be seen with a microscope. In all body cells, except the sperm and egg, CHROMOSOMES EXIST IN PAIRS.

Each cell contains several different chromosome pairs. Man has 23 pairs of chromosomes in each of his cells. Here are the number of pairs for farm animals:

Cattle	30	Pigs	19
Horses	33	Sheep	27
Goats	30	Chickens	6

Strung along the chromosomes, somewhat like beads on a string, are genes. Genes are thought to consist of complex molecules. They are chemically linked to the protein of the chromosomes. Genes are too small to be seen with a microscope. But other research methods tell us they exist.

Source: Dr. T. W. Wickersham, Extension Animal Scientist, Iowa State University

Genes are the units of inheritance. It is through genes that characters pass from parents to offspring. Genes are the "brains" of cells. They determine what the cell will be like. This, in turn, determines what the body will be like.

Since chromosomes come in pairs, so do genes. Two genes exist side by side. The total number of genes on a chromosome is not known. There may be several or many, depending on the chromosome.

The unique thing about genes and chromosomes is that they are able to reproduce themselves.

As an animal grows, its cells divide. Before a cell divides, the genes and chromosomes draw chemicals from the nutrients received by the cell. Then through an unknown process, each chromosome duplicates itself. When the cell divides, one member of each duplicated chromosome moves into the new cell. So the new cell contains exactly the same number and kind of chromosomes as those in the parent cell.

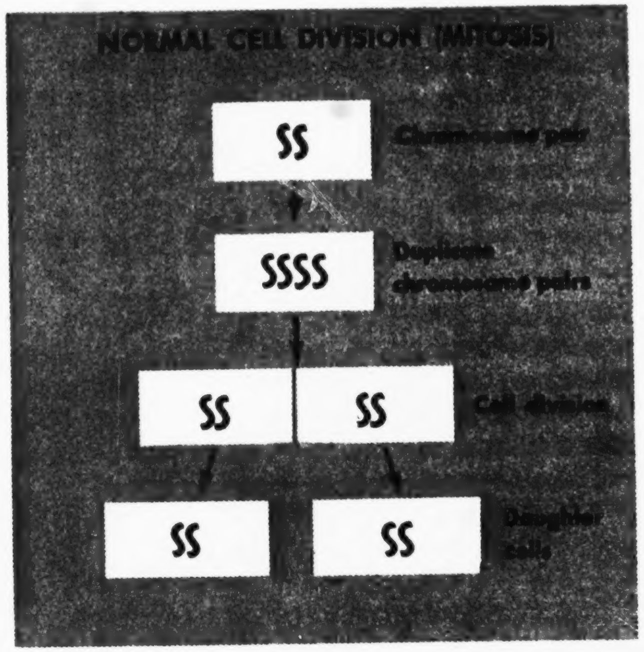
Chromosomes in Sex Cells

Genes and chromosomes act somewhat differently when reproductive cells are formed. In the testes of the male and the ovaries of the female, cell division takes another form. This is called reduction division (meiosis).

Instead of each chromosome reproducing itself, the pairs of chromosomes line up like soldiers and one member of each pair moves into each dividing section of the cell. Sperm cells and egg cells contain only a SINGLE chromosome of each original pair of chromosomes. In man, the sperm and egg cells each contain 23 single chromosomes instead of 23 pairs of chromosomes. An individual can make millions of kinds of reproductive cells because either chromosome of the pair may move into the reproductive cell. This makes possible millions of different combinations of genes and chromosomes in the reproductive cells of an individual.

When fertilization takes place, the single chromosomes of the sperm unite with the single chromosomes of the egg. Once again, *pairs* are formed. So the fertilized egg contains the same number of chromosome pairs as the cells of the parents.

When you consider that the slightest difference in gene make-up would cause a variation in the characteristics of the offspring, it's little wonder that no two people are alike. Except for identical twins, probably no two people in the whole world have exactly the same combinations of genes.



Dominant and Recessive Genes

Most characteristics are determined by several sets of genes. For this reason, it is almost impossible to tell exactly what an unborn animal will be like.

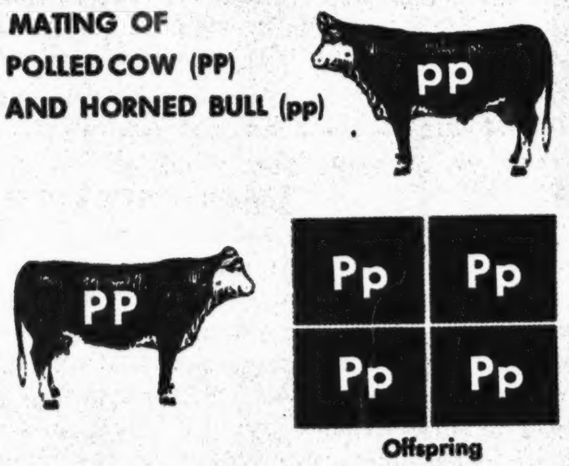
But there are a few characteristics determined by only one pair of genes. Horns in cattle provides one example. By studying characteristics such as this, we can learn something about how inheritance works.

Consider this problem: A cow that is truly polled (hornless) is bred to a horned bull. Will the calf have horns?

It will not. This is because the gene which causes an animal to be polled is *dominant* over the gene which causes horns to develop.

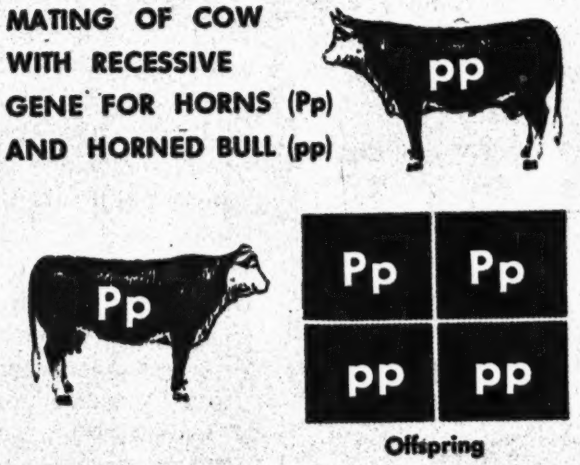
Let's explain. Let the capital P represent a gene for the polled characteristic. We use a capital P because polled is dominant. Since genes come in pairs, the genotype of the truly polled cow would be PP. (Genotype means genetic make-up.)

The genotype of the horned bull would be pp. The small p indicates the gene is *recessive.*



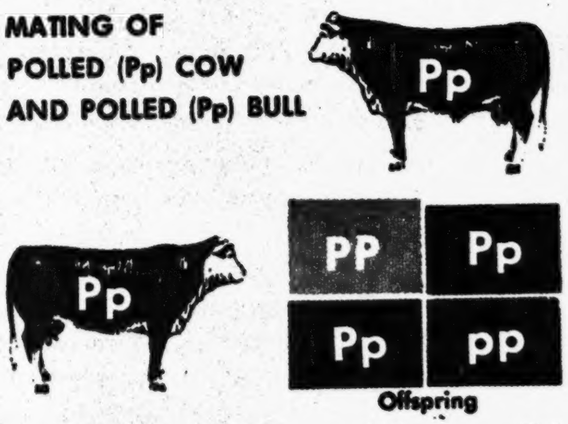
MATING OF
POLLED COW (PP)
AND HORNED BULL (pp)

All calves would be polled with a recessive gene for horns. (Pp)



MATING OF COW
WITH RECESSIVE
GENE FOR HORNS (Pp)
AND HORNED BULL (pp)

Half the offspring would appear polled (Pp). Half would be horned (pp).



MATING OF
POLLED (Pp) COW
AND POLLED (Pp) BULL

One-fourth of the offspring would be pure polled (PP). One-fourth would be pure horned (pp). One-half would appear polled but would carry the horned recessive gene. (Pp)

In reduction division in the cow's ovaries, the PP genes would separate. Each egg would contain a single P gene. Likewise, each sperm of the bull would contain a single p gene. (The other genes which would be present can be ignored in this example.)

When the sperm and egg unite, two genes influencing horn development would again be present. The genotype of the calf would then be Pp. Since the P gene dominates over the recessive p gene, the calf would be polled.

There would be no difference in the phenotype (outward appearance) of the calf and the cow. Both would be polled. But there genotypes would be different. The calf is Pp, the cow PP.

What then would happen if a Pp cow were bred to a horned (pp) bull?

Two possible kinds of eggs would be produced by the Pp cow. Half of her eggs would contain the P gene. Half would contain the p gene. All the sperm would contain the p gene.

In this case, it would be a 50:50 chance whether the p sperm united with a p or a P egg. The genotype of the calf would either be pp or Pp. Thus half the calves from such a mating would be polled and half would be horned.

For further understanding, we might figure out what would happen if a Pp cow were bred to a Pp bull. Both the cow and the bull would be polled in appearance. But both would carry a recessive gene for horns. Half the eggs would contain the P gene. Half would contain the p gene. The same would be true of the sperm.

Chances are 25 percent that a calf would have the PP genotype; 50 percent that it would have a Pp genotype; and 25 percent that it would carry a pp genotype.

Theoretically, if 100 such matings were made, 75 of the calves would be polled. Twenty-five would have horns. Of the 75 polled calves, 50 would carry a recessive gene for horns; 25 would be pure polled.

What would happen if a horned cow were bred to a horned bull? In this case, all the eggs and sperm would contain p genes. All calves would be horned.

Another characteristic that is determined by only one pair of genes is the color of Angus cattle. Most Angus are black. They carry a BB genotype. Some black Angus carry a Bb genotype. Red Angus cattle have a bb genotype.

What would be the genotypes of a black bull and a black cow which produced a red calf? Could red parents produce a black calf?

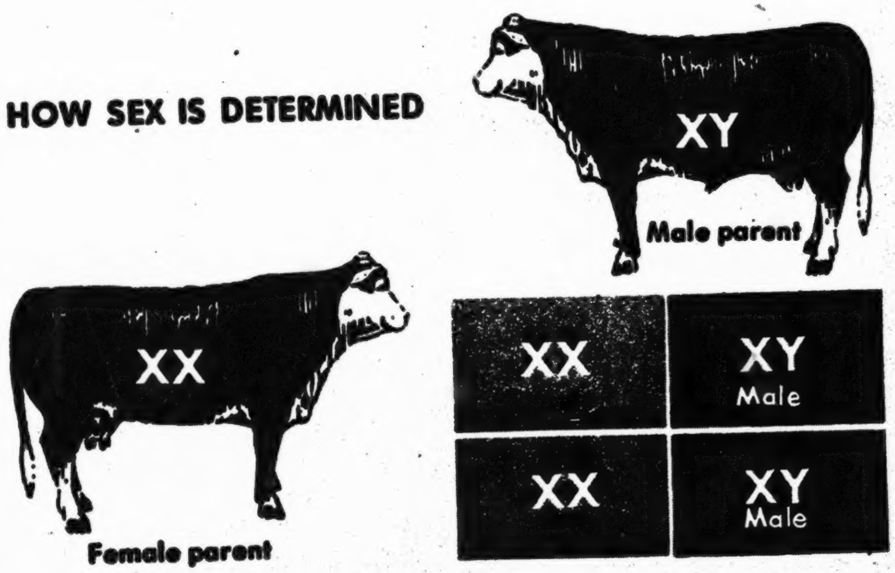
Inheritance of Sex

We can use a similar analysis to understand how the sex of an animal is determined.

In male mammals (cattle, swine, dogs, cats, man, etc.) there is one pair of chromosomes which does not exactly match. One is called an x-chromosome. One is called a y-chromosome. The sex genotype of males is therefore xy. (The small letters x and y do not mean that either is dominant or recessive.)

Females have two x-chromosomes. Their sex genotype is xx.

In reduction division in males, half the sperm cells contain an x-chromosome. Half contain a y-chromosome. All egg cells contain an x-chromosome.



HOW SEX IS DETERMINED

One-half of the offspring would be female and one-half would be male.

If a sperm with an x-chromosome fertilized the egg, chromosomes in the offspring would be xx. The fertilized egg would develop as a female. If a sperm with a y-chromosome fertilized the egg, the offspring would be xy. It would be a male.

The chances are 50:50 for the offspring to be male or female. That's the reason there are about equal numbers of men and women in the world.

Complications

So far, we have talked only about how inheritance works in its simplest form. This basic system forms the pattern for all inheritance. Complications arise only where characteristics are influenced by more than one pair of genes.

Most economically important traits, such as conformation, rate of gain and meatiness, are influenced by many genes. When several chromosomes and hundreds of genes are involved, it is impossible to figure out an animal's complete genotype.

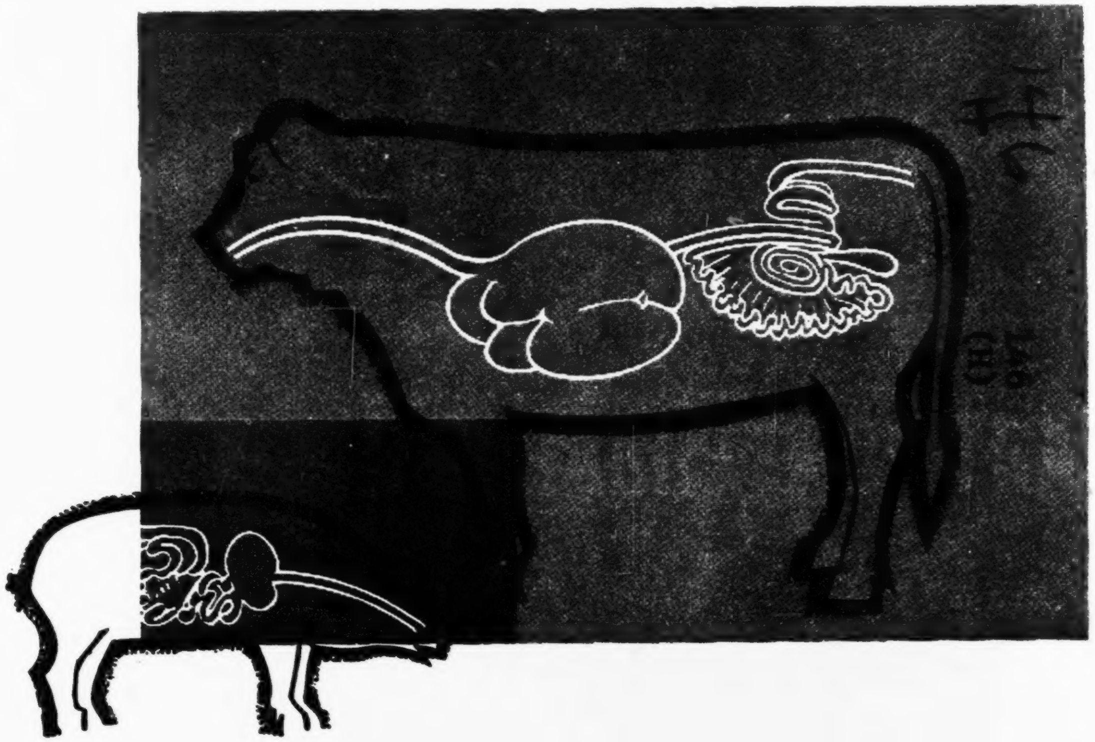
In addition, many genes are not clearly dominant or recessive. We can see this in some flowers. In certain kinds of flowers when a red-flowering plant pollinates a white-flowering plant, the flowers on the new plant are pink, instead of red or white. (Does this also explain roan coat color of Shorthorn cattle?) This is called incomplete dominance. When several sets of incompletely dominant genes are at work, the results are pretty hard to figure out. Fortunately for livestock producers, "good" genes seem to be dominant. This helps in improving livestock.

Finally, many things besides the genetic makeup affect an animal. A calf or pig may have the genes which enable it to make fast gains. But unless it is fed right, it will not produce those good gains. A diseased animal will not perform right no matter what its genetic make-up. An animal with genes for average gains that is *properly* cared for may do better than an animal with good genes that is *poorly* cared for.

Animal breeding is still a young science. There is still much to be learned. But animal breeding scientists have already discovered much which is helping improve farm animals.

#6

HERITABILITY OF TRAITS



In a certain locality there were 50 youngsters with baby beef projects. Each had two calves.

A committee weighed the calves at the beginning and at the end of the year. Average daily gains were calculated for each calf. The best gain was 3.0 pounds daily. The poorest was 1.5 pounds.

Why this difference (or variation, as it is called by animal breeding scientists)?

For one thing, the 100 calves were on 50 different farms. Each pair of calves was probably fed a different ration. They were housed in 50 different barns, and 50 different boys and girls cared for them.

These are environmental differences which influenced gains. Each pair of calves was in a different environment. You might say some members were better feeders than others.

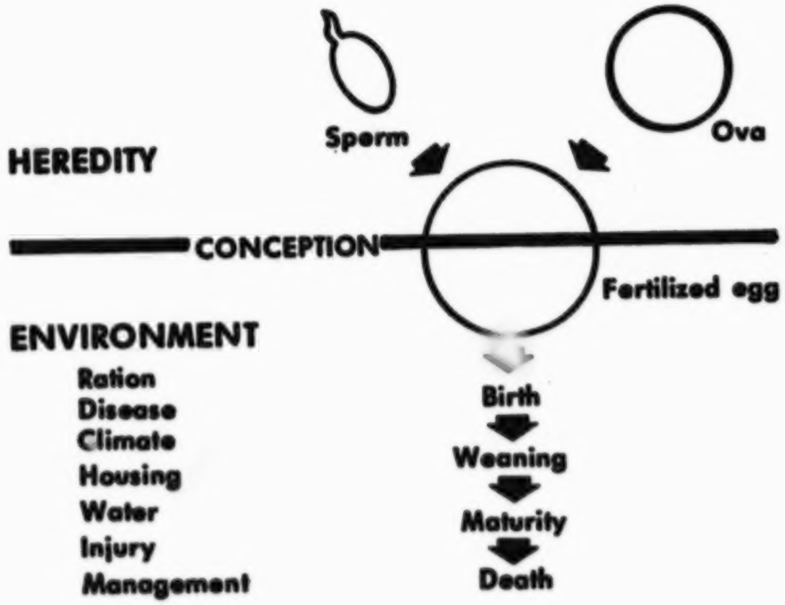
But how would you explain this: No one had two calves with the same rate of gain. Even though the two calves were fed alike and housed together, they gained at different rates.

We can explain this by genetics. The two calves had different heredity. Each calf inherited different genes which influenced its rate of gain.

Both heredity and environment cause variation in animals. The part of the variation caused by heredity is called heritability. Some traits, such as coat color, are almost completely determined by inheritance. They are high in heritability. Other traits, such as rate of gain, are only partially influenced by heredity. They range from high to low in heritability.

The heredity of an animal is determined when the sperm and egg unite. Anything which later affects the animal is environmental.

Source: Dr. T. W. Wickersham, Extension Animal Scientist, Iowa State University



High and Low Heritability

In the club members' 100 calves, there was a difference of 1.5 pounds in daily gains between the best and poorest calves. To find out how much of this variation was due to heredity, we multiply 1.5 pounds by 45 percent. (The 45 percent figure has been determined by scientists. It is the heritability of feed lot gains in beef cattle fed under similar conditions.)

1.5 x .45 = .68 pounds

This tells us that an average of .68 pounds of the variation was probably due to hereditary differences between the extreme calves. By subtracting .68 from 1.5 pounds, we learn that .82 pound of the variation was due to differences in the calves response to their environment.

Another heritability percentage which is known is that for litter size in hogs. In a herd of gilts, the average litter size is usually eight or nine pigs. That's only an average. Some gilts may give birth to 12 or more pigs, while some may have only two or three.

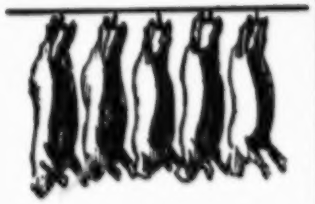
Can we say that the gilts with small litters definitely inherited a low reproductive rate? Probably not. Scientists have determined that the heritability of litter size is only about 10 percent. This means that 90 percent of the variation in litter size is due to environmental factors. Perhaps you can name some factors which might cause a small litter size.

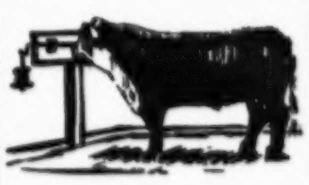
Following is a list of heritability estimates for traits in beef cattle and hogs. They have been arrived at by scientists after studying thousands of records.

	Hogs	Beef Cattle
Conformation score	30%	25%
Number born	10	–
Weights at weaning	10	30
Post-weaning feedlot gains	25	45
Feed efficiency	30	40
Length of body	60	–
Loin eye area	50	65
Thickness of fat covering	50	40
Percent ham	55	–
Percent fat cuts	60	–
Percent lean cuts	35	–
Tenderness	–	60
Carcass grade	–	35

Traits are usually grouped for convenience into low, medium or high heritability classes. Low heritability is less than 25 percent; medium is 25 to 50 percent; high includes traits over about 50 percent.

Note that traits relating to body structure and physical composition are more heritable than production traits, such as rate of gain and feed efficiency. Traits having to do with reproduction are quite low.





Using the Principle of Heritability

By selecting for traits, animal breeders improve their herds. The more heritable a trait is, the greater and the quicker improvement that can be made when selecting for that trait.

Let's study two illustrations. Say you are a beef cattle breeder. You want to improve the weaning weights of your calves. You weigh the calves in the fall and adjust the weights to take out the environmental effects of age of dam, sex and actual age. You find that the average adjusted weight of all calves is 400 pounds.

You decide that you will keep the heaviest heifer and bull calves in the herd. Their average weight is 500 pounds. You plan to use these for herd replacements. How will the offspring of the selected group perform compared with the whole group if no selection had been practiced?

Average weaning weight of selected calves — 500 pounds
Average weaning weight of all calves — 400 pounds
Difference 100 pounds

This difference is the reach or the amount you have selected. This will not all be transmitted, because you selected calves that were heavy for a mixture of reasons, both hereditary and environmental.

The heritability of weaning weight in beef cattle is 30 percent. Therefore, to find the predicted improvement, we multiply 100 pounds by 30 percent.

Difference x Heritability = Predicted Improvement
100 x .30 = 30 pounds

From this we estimate that the average weaning weight of the calves from these selected animals will be 30 pounds higher than the original 400 pound average. They are expected to average 400 + 30 = 430 pounds, assuming equal environmental conditions.

Thirty pounds may not sound like much improvement. But remember that 30 pounds means about $7.50 more income per calf. Remember too that the 30 pounds represents a genetic improvement in the herd. Genetic improvements are permanent, and can be added to generation after generation. The stockman states it this way: "Each generation stands on the shoulders of the last."

Here's another example using the backfat thickness in hogs. Say you are a commercial swine producer. You sell some hogs, and the buyer reports that the backfat thickness averaged 1.8 inches. You decide that too many hogs are No. 2's and No. 3's. There are not very many No. 1's.

So you select a boar with 1.2 inch of backfat to sire the next crop of pigs. In order to keep our example from getting too complicated, let us assume that the breeding gilts are unselected and are genetically comparable to the barrows, which averaged 1.8 inches backfat. (Ordinarily gilts would be selected which have less backfat than the herd average and less than 1.8 inches.)

A boar with 1.2 inch backfat is about 15 percent "leaner" than if he were a market barrow. This is called the sex effect. Therefore, *genetically on a barrow basis* he has backfat of 1.4 inches (1.2 x 1.15 = 1.4).

We mate the boar that has genes for 1.4 inches backfat to gilts with genes for 1.8 inches. We can predict the backfat of the offspring and the improvement resulting from this mating.

Average backfat of gilts selected for breeding — 1.8 inches
Backfat of boar . . . : . . . . — 1.4 inches
Difference . . . . —-0.4 inch

The heritability of backfat thickness in swine is 50 percent. But in this example, we have no improvement in the gilts. Since the boar and gilts each transmit one-half their genes to the offspring, the pigs are expected to get no improvement from their mothers but .5(-0.4/2 inch) = -0.10 inch from their sire. The average backfat thickness of the next pig crop would be 1.80 - 0.10 = 1.70 inches. They are better, but still not good enough to have a high percentage of No. 1 carcasses. The heritability of 50 percent is high enough so that we get a big chunk of what we reach for. But the process will have to be continued for several generations, or a better boar used, or some selection practiced on the gilts, to attain the goal of a high percentage of No. 1's.

We reached for 100 pounds added calf weaning weight. We got 30 pounds or 30 percent by selecting in both sexes. In the pigs, we reached for 0.4 inch less backfat in the boar only. We could have got 0.2 inch or 50 percent there if the gilts had been selected equally.

Key Scientific Ideas

From our discussion so far we can pick out four key scientific ideas about genetic improvement:

1. Any animal, at any time, is the product of its heredity and of the environment to which it has been exposed.

This is why livestock judges cannot accurately tell which animal has the best genes. Good fitting and showmanship will make an animal look better than it really is. A poor job of fitting and showing will make an animal with good genetic make-up appear poorer than it really is.

Breeders have sometimes been disappointed in the calves or pigs out of a bull or boar that had a good show record. They say he did not breed like he looked. On the other hand, some pretty average looking bulls or boars have come through as "good breeding sires."

The advantage of testing programs for bulls and boars is that varying environmental influences are held to a minimum. The differences observed are more nearly due to genetic make-up. Animals tested or developed under deliberately standardized conditions can be selected with less tendency for environment to mask heredity.

2. Some traits are more heritable than others.

Heritability estimates for important traits have been determined by scientists. They range from zero to 100 percent. Knowing the heritability of traits helps breeders know about how much improvement to expect. They can figure when animals are living up to their genetic potential. And they can more wisely concentrate selection on traits where the most improvement will result.

3. The more highly heritable the trait, the more effective selection will be for it.

Swine breeders have been amazed at the improvement they have made in about 10 years of selecting for lean, "meat-type"hogs. The percent of lean cuts is a trait with medium to high heritability. When breeders decided to improve this trait, they were able to accomplish much because leanness is largely determined by genes. Boars with genes for leanness transmit them to their offspring. These will be a major influence in causing the offspring to be lean.

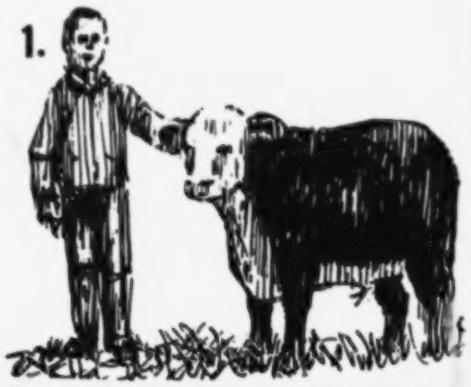
In contrast, breeders could spin their wheels for a lifetime trying to improve a trait with low heritability.

4. Objective measurements for traits give the best indication of genetic merit.

For example, the best way to evaluate the inherited gaining ability of an animal is to actually weigh the animal. You would weigh the animal at the beginning and at the end of the feeding period, and you would compare its gains to those of animals that were fed and cared for exactly like it. A scale weight is an actual measure of weight. There would be no reason to estimate gaining ability from the "looks" of an animal.

In this case, the "objective measurement" means using actual weights. It also means using a "fair" test. When a group of animals is fed and cared for exactly alike, you can be sure that the differences in their gaining abilities are due mostly to *heredity*, not to environment. Your measurements would be meaningless if the animals being tested were each fed a different ration.

1.



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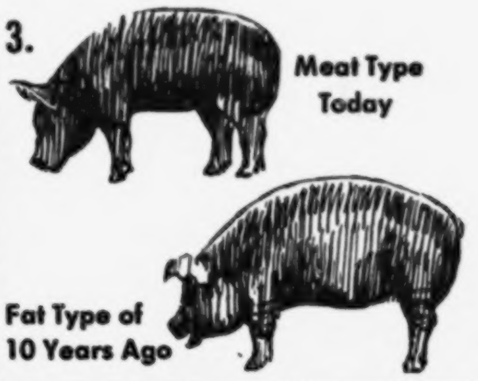

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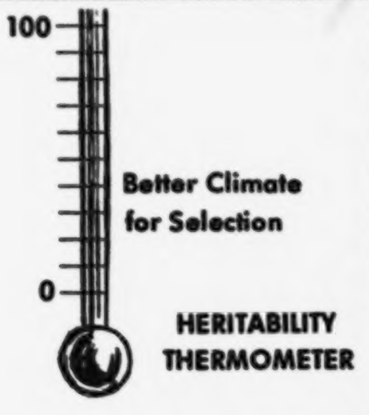


4.

Lesson 3. Improving a Swine Herd Genetically 2 days

OBJECTIVES:

1. To understand how various breeding systems have been used to improve our livestock.
2. To realize that upgrading is a slow process, particularly at the upper levels.
3. To see how artificial insemination can help improve herds.
4. To realize the value of hybrid vigor.
5. To consider improvement of a commercial swine herd.

REFERENCES:

Livestock and Poultry Production, pages 55 - 60

		Page
Handouts:	"Improving a Swine Herd"	153
	"Improving Beef Herds"	157
	"Pre Quiz"	161

AS 65 Slides 92 - 97

MOTIVATION:

Give students the "Pre Quiz" Handout. Promise to discuss questions at end of this lesson.

OUTLINE:

A. Breeding Systems
   1. Purebred breeding: mating purebred boars to purebred sows of the same breed.
   2. Upgrading: mating purebred boars to grade sows of the same breed.
   3. Crossbreeding: mating purebred or inbred boars of one breed with sows of another breed.
   4. Criss-crossing: mating a boar of one breed to sows of another, then switching to the other breed when selecting alternate boars between the two breeds for succeeding generations.
   5. Rotation breeding: using different breeds of boars on 3 or 4 succeeding generations of sows, then returning to the first breed used and repeating the series.

6. Inbreeding: mating boars to closely related sows of the same breed: brothers and sisters, sires with daughters.
7. Line breeding: mating boars to sows of the same line, but not so closely related as in inbreeding.
8. Crossline breeding: breeding inbred boars of one line to inbred sows of another line in the same breed.

B. Artificial insemination: semen is collected, diluted, stored and later used by a highly skilled technician to breed females.

C. A Swine Improvement Program
   1. Identify each sow and each of her pigs.
   2. Start a written record when each sow farrows.
   3. Weigh each pig at 154 days.
   4. Probe those gilts that qualify on weight.
   5. Appraise the fast-gaining, low-probing gilts visually.
   6. Obtain as much market and carcass data as possible.
   7. Study records; determine greatest weaknesses; and buy a good boar especially strong in herd's weak traits.

PROCEDURES: *

1. Briefly discuss the different breeding systems. List them on chalkboard. Consider some situations where one would be better than another.

2. Who has seen a cow inseminated artificially? What advantages does this system have?

3. Consider the swine improvement program after students have studied the handout "Improving a Swine Herd." Emphasize the scientific principles, especially those related to genetics and reproduction.

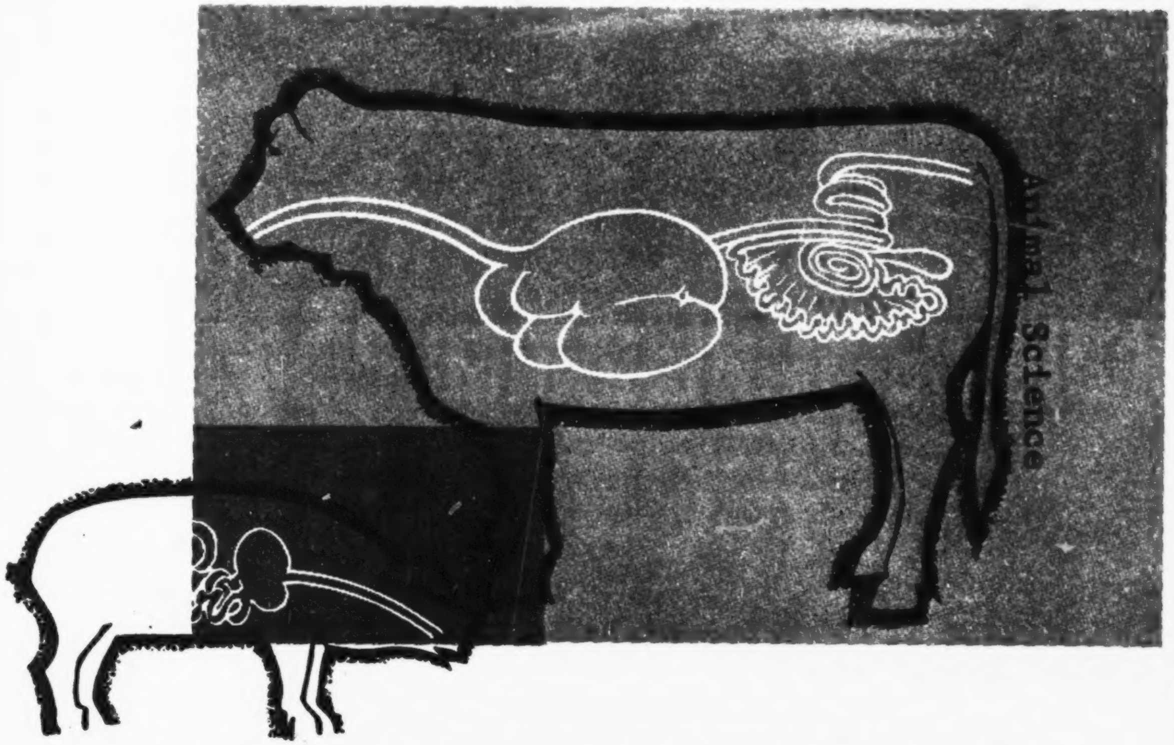
4. Show the slides 92 - 97.

5. Go over the Pre Quiz.

* Some may prefer to base this lesson beef herd improvement. They may do so by using the handout "Improving Beef Herds" and slides 76 - 91.

SUMMARY:

IMPROVING A SWINE HERD



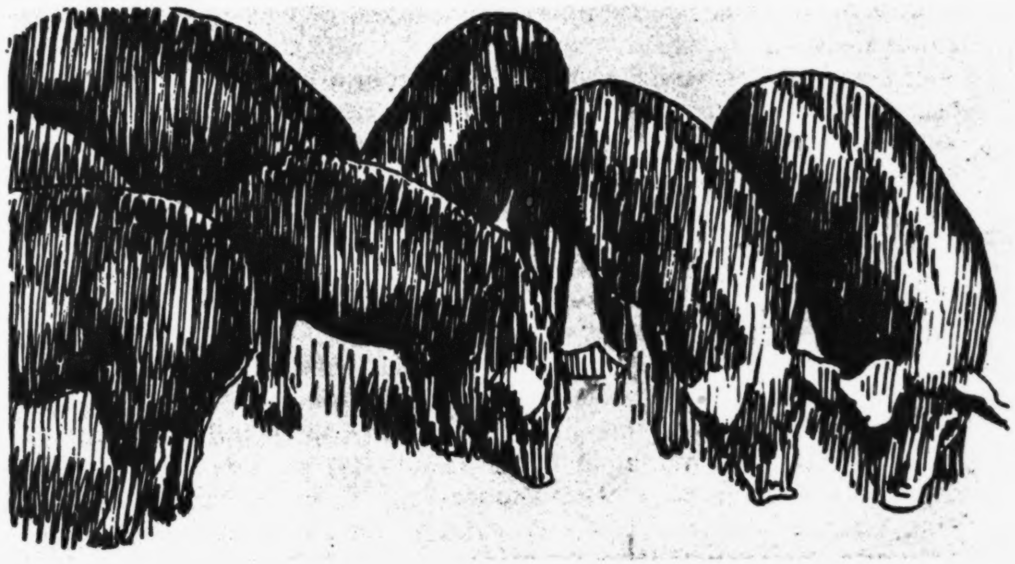
Production in almost any herd of hogs can be improved. A producer can often boost his profits by upgrading his nutrition, management, health or marketing program. This will improve the litters being raised now. But there is another kind of improvement that is more lasting. A breeding and selection program will improve the genes of a herd. This is permanent improvement.

In previous lessons you learned a few principles of genetics. Through selection programs, these principles are put to work on the farm.

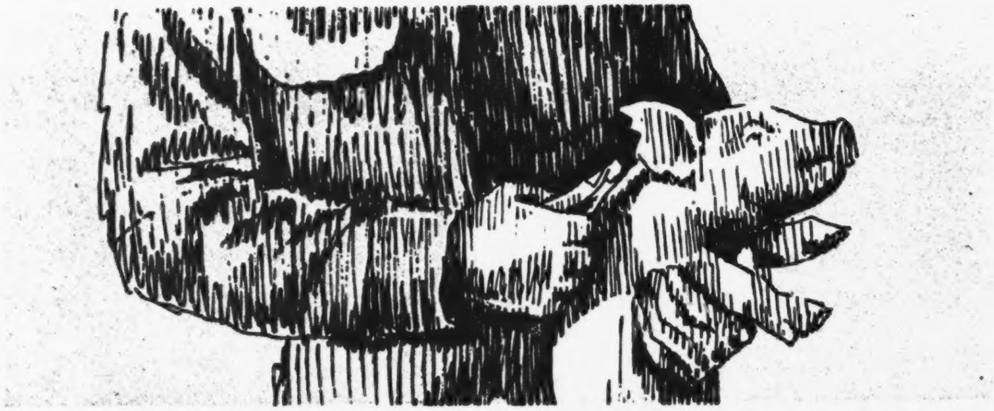
Take a herd of average crossbred sows, for instance. How would you use a knowledge of genetics to begin improving your market hogs and to upgrade the breeding stock?

First, you might consult someone who has received training from an animal breeding scientist. Most states have a proven selection program to follow.

Let's take a look at a typical improvement program. In it you can see genetic principles being applied. There are usually seven steps involved.



Source: Dr. T. W. Wichersham, Extension Animal Scientist, Iowa State University



Step 1. Identify each sow and each of her pigs at farrowing. This is usually done by ear notching.

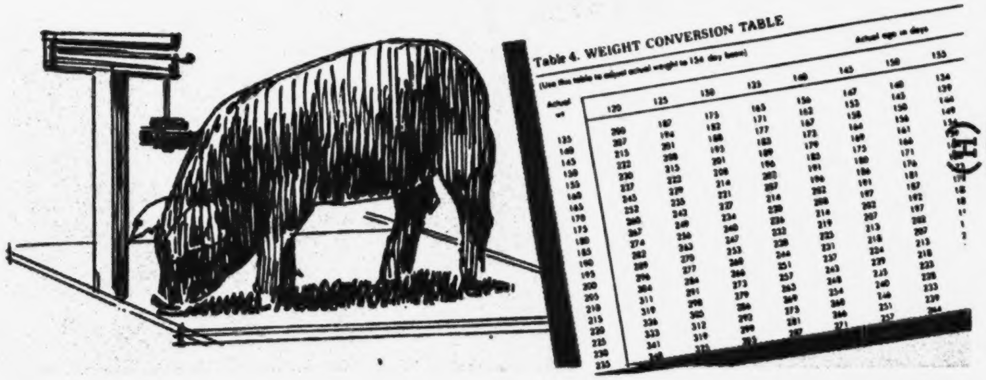
The scientific principle here is that even pigs from the same litter will have different genes. The best *individuals* are selected, not the best litters. So you must identify each individual animal.

Step 2. Start a written record when each sow farrows. The record need not be fancy. A pocket notebook or a card tacked to the farrowing pen will do. The information is: the sow's number; the sex and ear notch of each pig in the litter; the farrowing date; information about the sire; the number of live and dead pigs farrowed; and some notes on the mothering ability of the sow. Special notes can be made of vaccinations, changes in rations, etc.

Good written records are a must for any improvement program. A hog producer cannot possibly keep everything in his head. Any good farmer, businessman or scientist is a good record keeper.

Step 3. Weigh each pig when it is about 154 days old (5 months). Of course, it would be hard to weigh every pig when it is exactly 154 days old. You can weigh several litters at the same time. Then by using a "weight adjustment table," you can estimate the 154-day weights of pigs that are slightly over or under this age.

These weights are used to compare the growth rates of the pigs. The heavier the pig, the better its growth rate. In choosing replacement gilts, you select those with the highest 154-day weights (other traits being equal). In a well-managed herd, about 180 pounds is the lowest you should choose. In any case, choose only from the top one-half of the gilts. You can also use 154-day weights if you plan to keep some of the old sows. You would keep the sows that raised the most pigs and whose pigs had the highest 154-day weights.



Two scientific ideas are involved in step 3. (1) Remember that breeders select for economically important traits. And they select for traits with heritability that is medium or higher. The ability to make fast gains is very important in swine. Rate of gain has medium heritability.

(2) In selecting for traits, accurate, objective measures should be used. We do not guess the 154-day weights of pigs. We actually weigh them using an accurate scale.

Step 4. Probe the gilts that have qualified on weight. Probing measures the fat thickness over the pig's back. You have probably seen this done or demonstrated. Probe measurements are taken at three points on the back. The "backfat thickness" is the average of the three probes. (The average is their sum divided by three.)

The gilts will have different weights when they are probed. So again it is necessary to use an adjustment table. This will correct the actual probe figures to a standard of 200 pounds. Gilts with the least backfat are the ones to choose for the breeding herd. Gilts with more than 1.3 inches of backfat are usually not chosen. If this standard can't be met, particular emphasis should be given meatiness in the choice of a boar.

Step 4 also has two scientific bases. (1) Research proves that the backfat probe is the best known way to predict meatiness in live pigs. For hogs of equal weight, the greater the probe measurement, the less lean cuts. The lower the probe, the more lean. Meatiness has much economic importance. When we select gilts with low backfat, we are indirectly selecting for meatiness.

(2) All gilts in a herd usually have the same environment. They are fed, housed and managed alike. Therefore, differences in their backfat must be due to a considerable extent to differences in their genes. Since genes are passed on to the offspring, gilts with low backfat that are used for breeding will pass on the important trait of meatiness.

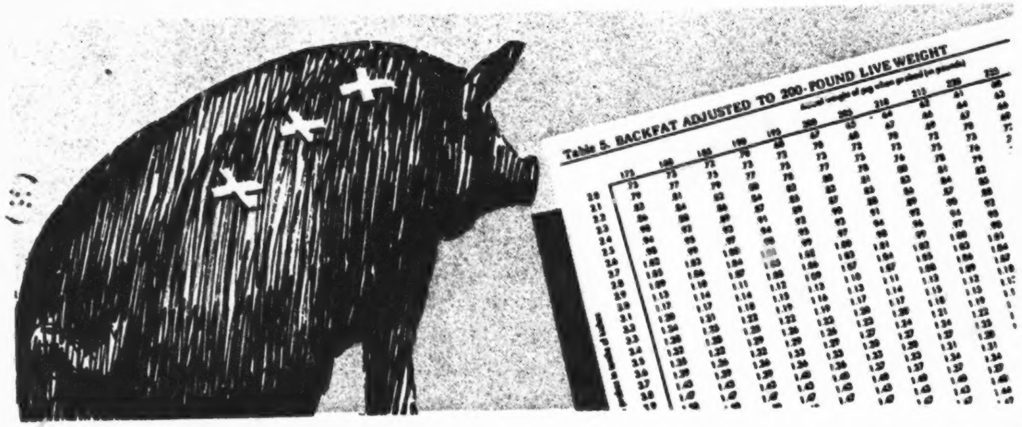


Table 5. BACKFAT ADJUSTED TO 200-POUND LIVE WEIGHT

Step 5. Examine the fast-gaining, low-probing gilts for physical defects. Count the teats on the underline, and appraise the general soundness of the mammary (milk-producing) system. Also appraise the soundness of the feet and legs. Finally, evaluate the gilts for conformation. Pay special attention to *muscling* in the *ham* and *loin*. Also look for reasonable length of side, for a trim jowl and feminine head. Reject gilts that have defects or that definitely lack ham, loin or length.

There is a scientific principle here, too. Some traits can be accurately appraised with the eye. Some cannot. Number of teats and physical defects can be "eyeballed" satisfactorily. We should use eye appraisal only for traits for which it is suited. We use more accurate measures, such as scales and the probe, for traits for which they are suited.

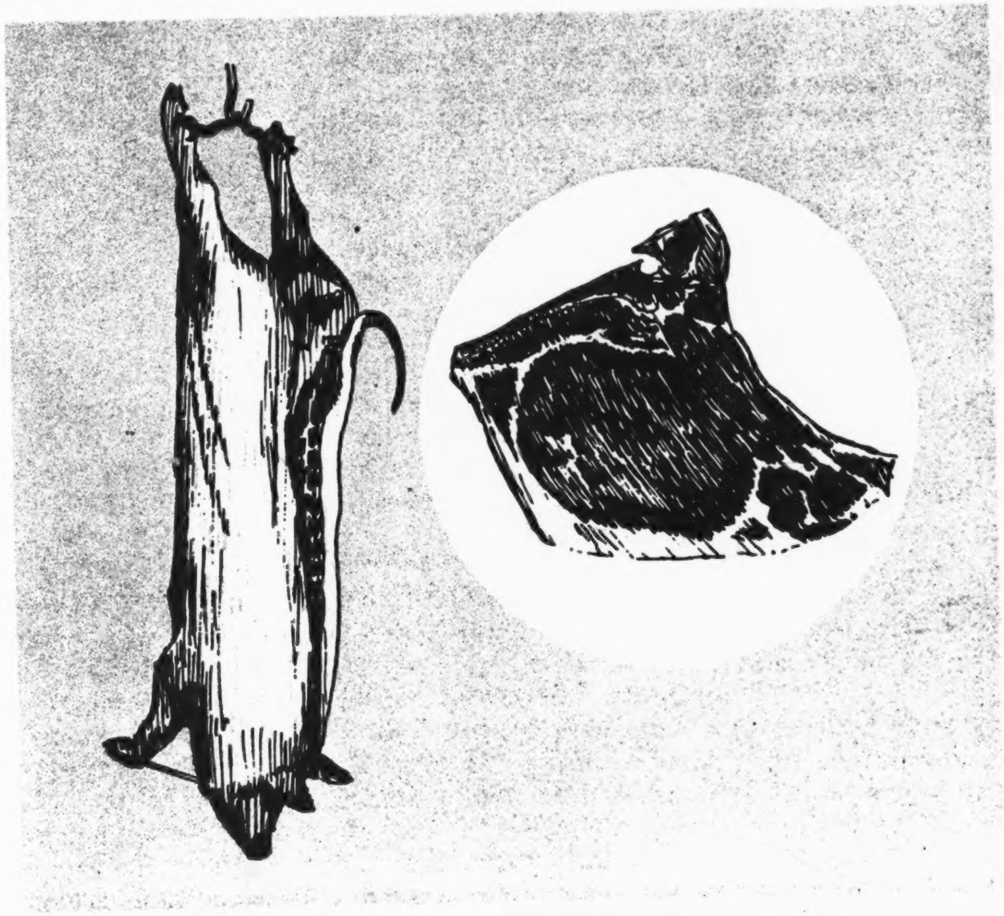
Step 6. Get as much market information as you can on the barrows and market gilts you sell. Ask the buyer to give you carcass grade, backfat and length on at least one truckload of your hogs. On all hogs, get an estimate of the percentages of No. 1's, 2's and 3's. The national average is about 35 percent No. 1's. If 50 percent or more of the hogs you market grade No. 1 and they have good ham and loin development, you are producing meat-type hogs. If you are marketing a lower percentage No. 1's you should concentrate (put selection pressure) on increasing meatiness.

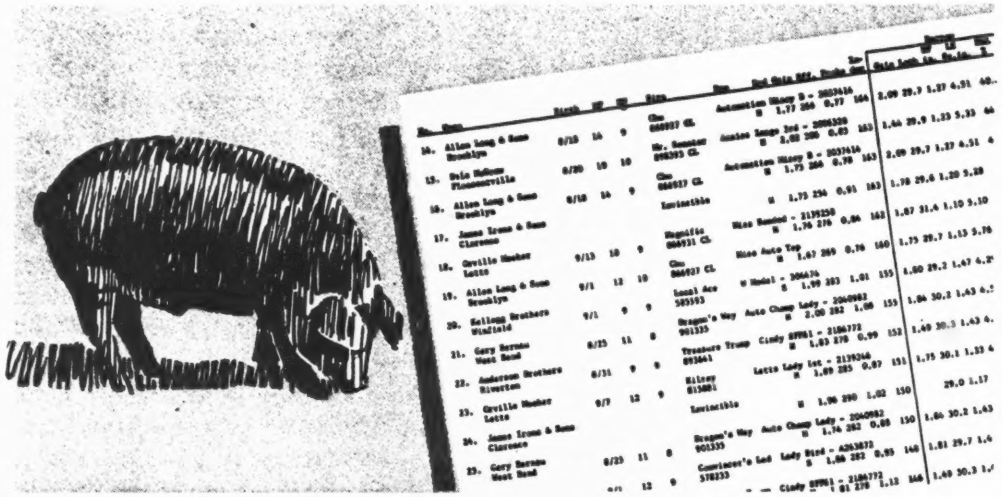
Also enter a market hog show which has a carcass contest. This will give you more detailed carcass information on a selected sample of your hogs. In many carcass contests each hog carcass must first meet certification standards. The standards are 1.6 inches or less backfat, 29.0 inches body length and 4.0 square inches of loin eye. In many contests the trimmed hams and loins are weighed. Then the percentage of ham and loin in the carcass is calculated. The hog with the highest percentage of ham and loin is the winner.

Carcass evaluation involves much science—both animal science and the science of economics. Economists who do "consumer preference" studies tell us that pork has lost some consumer demand. This simply means that people are less willing to buy pork. The apparent reason is too much fat in the pork. Hog raisers are increasing consumer demand by producing more lean pork. Lean pork has excellent nutritional value and ranks high on a "repeat business" scale.

Carcass and live grade information tells hog producers whether their animals are satisfactory. With this information they can better plan their breeding programs. (Meatiness can be improved most by using meaty breeding stock.)

Meat scientists have given us the tools for evaluating hog carcasses. For example, they have found that ham and loin percentage is a good indicator of total lean cuts.





Step 7. Study the records on your gilts and decide what traits need improvement the most. Then buy a boar with an outstanding over-all record (index) but with a very strong score in the traits your herd is weakest in.

You would buy the breed of boar that best fits a planned rotational crossbreeding program. There are two good places to buy boars. One is a boar testing station. The other is from a herd owner who has participated in testing or in breed improvement programs. In either case, you have actual performance records to guide your decisions.

The scientific principles behind these suggestions are:

1. In each herd, certain traits need more improvement than others. Your 154-day weight records might show a need to improve rate of gain most. Backfat probe records might show a need to buy a boar with very low backfat. If your gilts were too short, you would buy a boar with exceptional length. You would not ignore over-all merit, however.

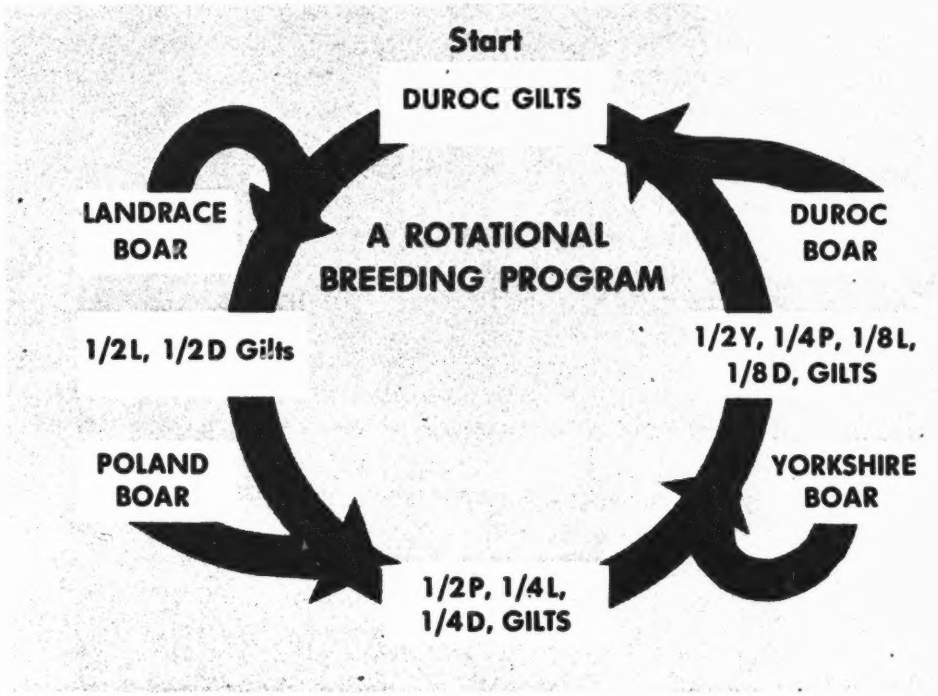
2. Once again, actual records are the best measure of genetic merit. Boar testing stations give factual records on gaining ability and backfat thickness. Often, information on the feed efficiency of a group of pigs closely related to the boar is also available. And carcass information on a litter mate may be given.

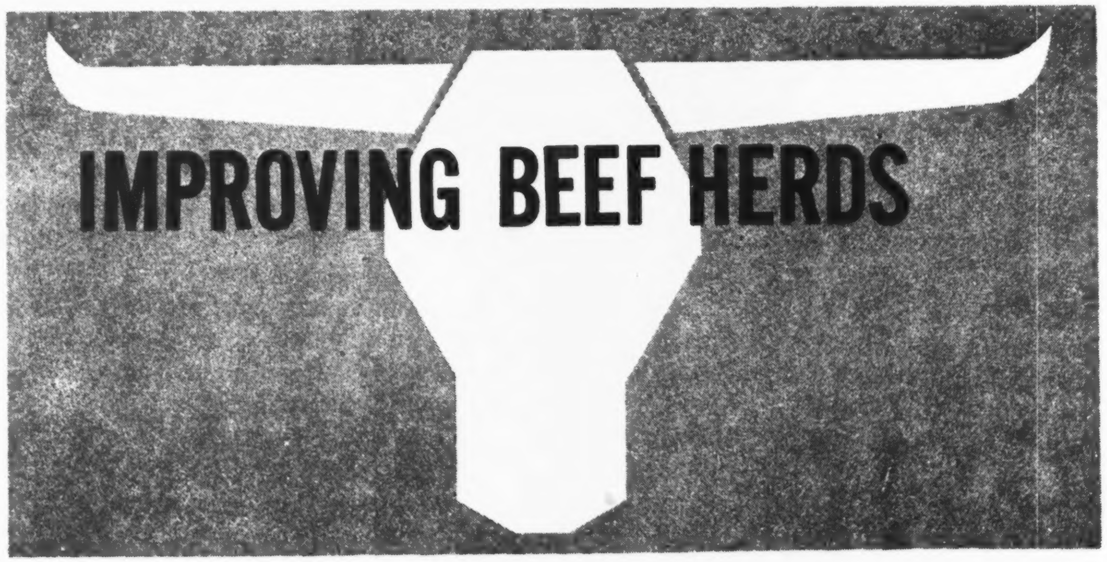
Breeders who have taken part in testing station and breed certification programs often have gain records and probe data on their boars. They may also have carcass cutout information on half brothers or sisters of boars.

3. Crossbreeding gives "hybrid vigor" (heterosis) in hogs. In other words, pigs from parents of two different breeds are more "vigorous" than purebreds. Certain traits can be improved more quickly in crossbreeds than in purebreds.

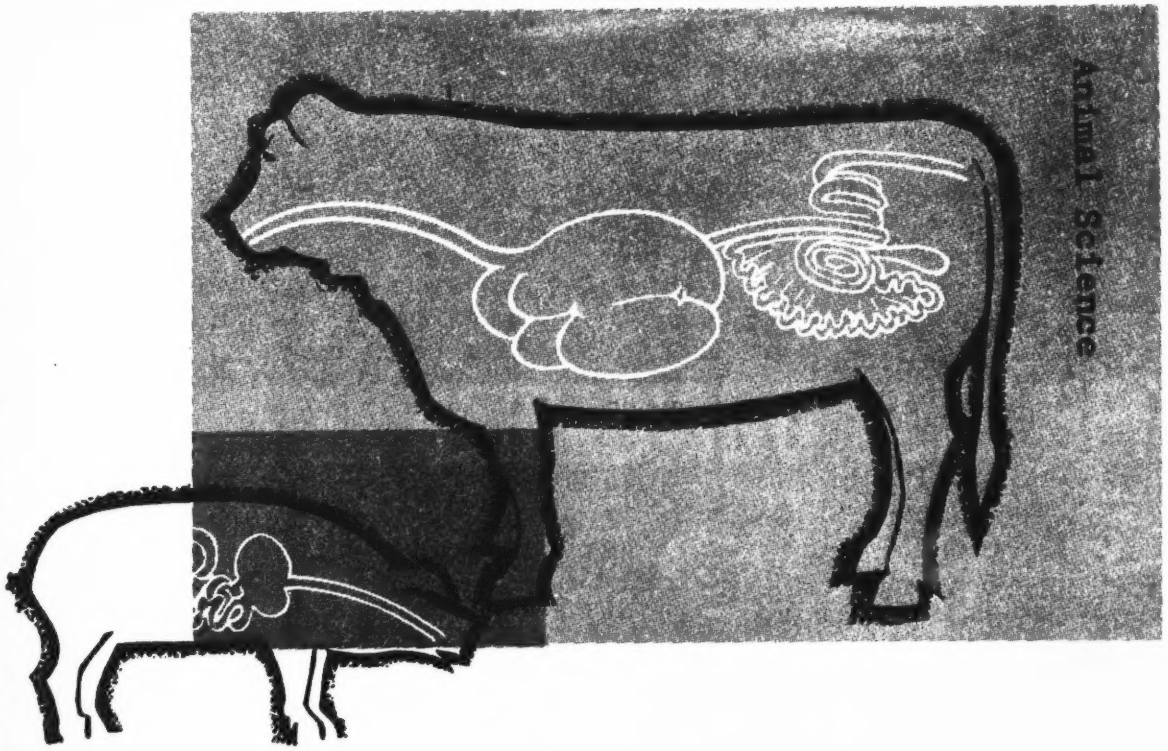
Most modern commercial hogs are crossbred. Swine raisers have found that crossbreeding gives them improvement in one or more of the important traits. These may include litter size, birth weight, livability, mothering ability, growth rate and disease resistance.

Usually two or three breeds are used in crossbreeding. They are used in a definite order. The outstanding characteristics of several breeds can be obtained in the crossbred pig. If good seed stock boars are used, and care is exercised in selecting the gilts, a high level of performance will be maintained. You won't find a tendency for the crossbred stock to deteriorate or "run out." It isn't likely that every mating will be perfectly successful. That is expecting too much, even with the best breeding program. But consistently high-level performance *can* be maintained and corrective procedures can be made in selecting replacement boars and gilts if minor faults appear.





IMPROVING BEEF HERDS



The days of the Texas longhorn are gone. A century ago the trails of the West saw cowboys driving vast range herds to market. It must have been a colorful sight. These were native cattle, the descendants of cattle brought to the New World by the Spanish. It was an exciting era in American agriculture.

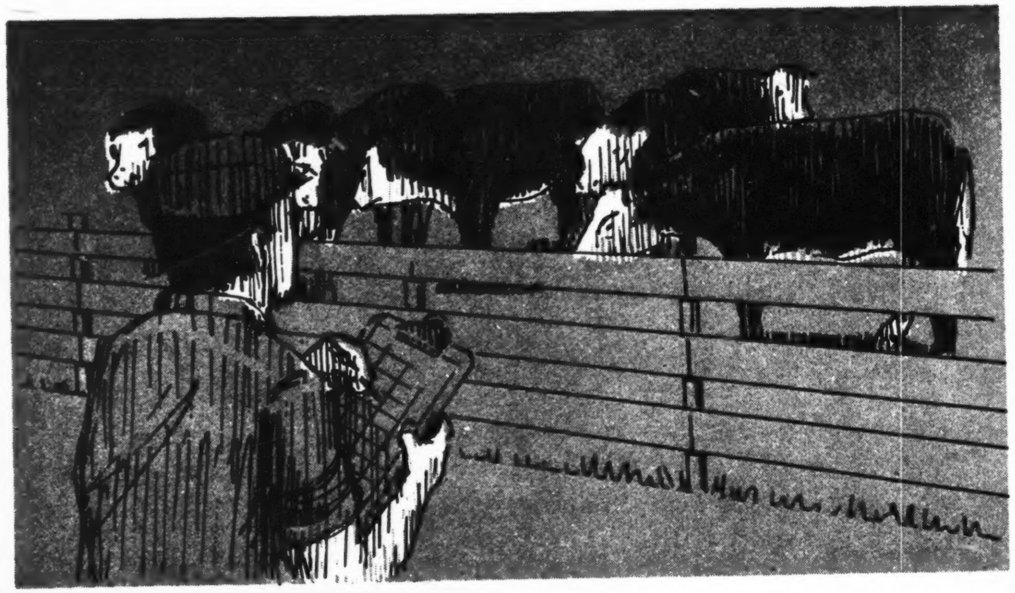
Those picturesque longhorns were adapted to the extensive ranching conditions of the 1850's, but longhorns weren't very good eating. And as time passed, cattlemen began to discover they could make more profit by using different management practices and by changing their cattle. The native, longhorn cattle were changed to shorter legged, blockier, earlier-maturing animals. This was done mostly by using imported British bulls.

You can see that improving beef cattle has long been a goal of breeders. Today, cattlemen are still improving their animals. And they have modern scientific methods to help them. The old-time cattlemen were mostly trying to change the shape of their cattle. Modern breeders are becoming interested in improving other traits.

If you were a beef breeder, what traits would you try to improve? How would you use a knowledge of genetics to help you? How would you proceed?

Many states have outlined beef breeding programs suited for their areas. They are called Performance Testing, Production Testing, Record of Performance or On-Farm Testing programs. You should become familiar with your state's program.

Source: Dr. T. W. Wickersham, Extension Animal Scientist, Iowa State University



Traits to Improve

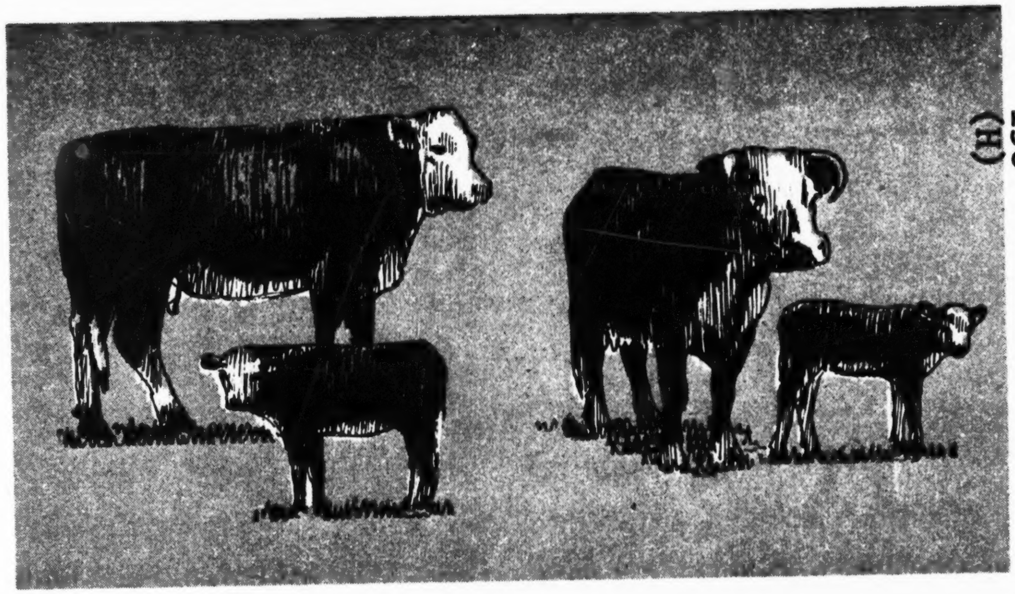
The first problem in beef improvement is deciding what traits to improve. There are many traits a breeder might select for. Common sense and scientific facts help make the decision.

First, it make sense to select for those things which will increase profits. These are called "economically important traits." We want low-cost production of desirable beef. A breeder would not increase his profits with an improvement plan to get a particular color of cattle. Hair color is not an economically important trait. It would pay, however, to improve feed efficiency.

Next, science tells us that the most improvement can be made by selecting for traits that are transmitted strongly to the offspring (highly heritable). A breeder accomplishes little by trying to improve a trait that has low heritability.

Thirdly, to make real improvement, the fewer traits selected for, the better. The most progress for a trait will be made if all the selection is for that trait. If more than three traits are in the selection program, progress will be slow and limited on each.

In summary, we want to select for economically important traits that are highly heritable. And we want to select for only a few traits at a time. Let's take a look at some traits and see how they can be improved.



Mothering or Nursing Ability

Scientific study has set the heritability of nursing ability at about 30 percent. This trait is economically important because much of a calf's growth comes between birth and weaning. It is easy to see the importance of this trait. Which cow would you select—one with a 375-pound calf or one with a 525-pound calf beside her at weaning?

The mothering ability of cows can be quite accurately measured. It is done simply by weighing their calves at weaning. The heavier the calf, the better the cow's nursing (milking) ability. This is similar to weighing the milk from a dairy cow to evaluate her milking ability, but is much easier because only one weight is required.

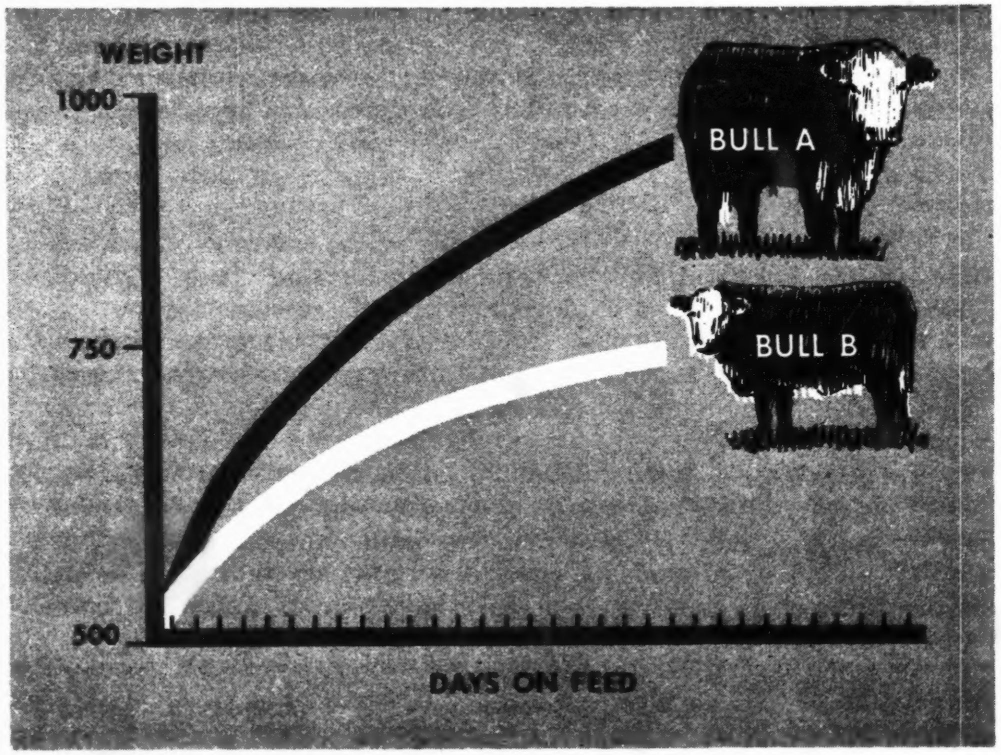
In most beef herds all the calves are weaned at once. They are weighed at this time to check their mothers' nursing abilities. Because all the calves are weighed at once, there will be differences in their ages. Also, the sex of the calf and the age of the cow make a difference in figuring mothering ability. In order to make fair comparisons between the calves, their actual weaning weights must be adjusted, taking age and sex factors into account. In state-wide improvement programs, these adjustments are usually done by electronic data processing machines. This is often a service to herd owners who participate in organized herd improvement programs.

These adjusted weights are the basis for culling cows from the herd. Cows whose calves have the highest adjusted weights are kept. Cows with the lightest calves are culled. There is no exact line between cows to keep and cows to cull. This is because pasture, range and management vary with the location.

There are two principles to remember in selecting for nursing ability:

1. *Improvement results only when the superior animals are used for breeding and the inferior ones are culled.*

2. *The environment of animals must be alike if valid comparisons are to be made.* It would be unfair to compare weaning weights if some of the calves had been creep fed and others had not.



Growth Rate

Growth rate is another easily measured trait which might be improved. It is 45 percent heritable. Growth rate is important because it is closely related to economy of gain. You would not hesitate in buying a calf that would gain 3 pounds daily instead of a calf that would gain only 2 pounds. It is as simple as that. The better-gaining calf will have a lower cost of gain. You will have more pounds of beef to sell for a given amount of feed, or you would be able to finish the calf in a shorter time. All in all, the faster-growing calf is more profitable.

Growth rate can be selected for directly. In the past the selection for growth rate has been done by selecting for conformation traits which were thought to be related to growth. You may have heard a livestock judge say, "This is a growthier heifer." He probably noticed the heifer had long legs or a long body.

Why have breeders relied on eye judgment to select for growth rate? Why have they not used a scale and selected for growing ability directly?

Growth rate can be accurately measured. The most common method on farms and ranches is to put bull calves on a feedlot test immediately after weaning. The calves would be weighed. Then a good ration would be full-fed for at least 140 days. At the end of this time the bulls would be weighed again. By dividing the amount of gain by the number of days on test, the average daily gain of each bull is figured. Average daily gain is a direct indication of growth rate.

Another way of measuring growth rate is to weigh all calves when they are about 18 months old. The weaning weight is subtracted from this 18-month weight, and average daily gain is figured. This kind of measurement may fit into the herd management program, especially for heifers.

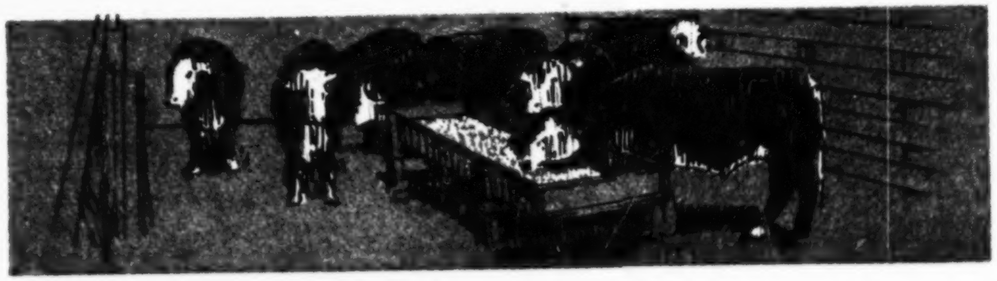
Two principles stand out as guides to improving growth rate.

1. *There is a great deal of variation in the ability of individual cattle to gain.* It is not unusual for bulls from the same herd to vary considerably. The range may be from less than 2 pounds daily to more than 3 pounds.

2. *The ability to gain is transmitted from parent to offspring.* Therefore, improvement will result if growth rate is selected for. Using sires that have superior gaining ability will improve the gaining ability of the herd.

To select for gaining ability a cattle breeder would feedlot test the bull calves with the *best weaning weights.* After the feedlot test he would sell only the superior gaining bulls as breeding bulls. If you were buying a bull, you would choose one with a good daily gain record.

Selecting fast-gaining animals for the breeding herd is doubly important. The two traits of gaining ability and feed efficiency are interrelated. If you improve gaining ability, you improve feed efficiency.



Feed Efficiency

Feed efficiency is a ratio of the amount of feed needed to produce a unit of weight gain. In beef cattle it is about 40 percent heritable. A tested bull that converts 6 pounds of feed into a pound of gain has higher feed efficiency than one that eats 10 pounds of feed to make a pound gain. Feed efficiency ratios are like golf scores, low ones are best.

On a farm or ranch, it is almost impossible to keep track of exactly how much each animal eats. So it is impossible to measure feed efficiency. Fortunately, feed efficiency can be selected for indirectly by selecting for rate of gain. Scientists have found a high correlation between rate of gain and feed efficiency.

Off the farm, at a bull testing station, feed efficiency can be measured directly. Each bull is fed separately, and accurate feed consumption records on each one can be kept.

Conformation

The final item considered in a selection program is conformation. Conformation scores are 25 to 40 percent heritable, depending on the age when taken.

When we speak of conformation, we mean those traits that contribute to carcass desirability and structural soundness. (Remember that performance traits, such as growth rate, should be measured and selected for directly—not through conformation traits.)

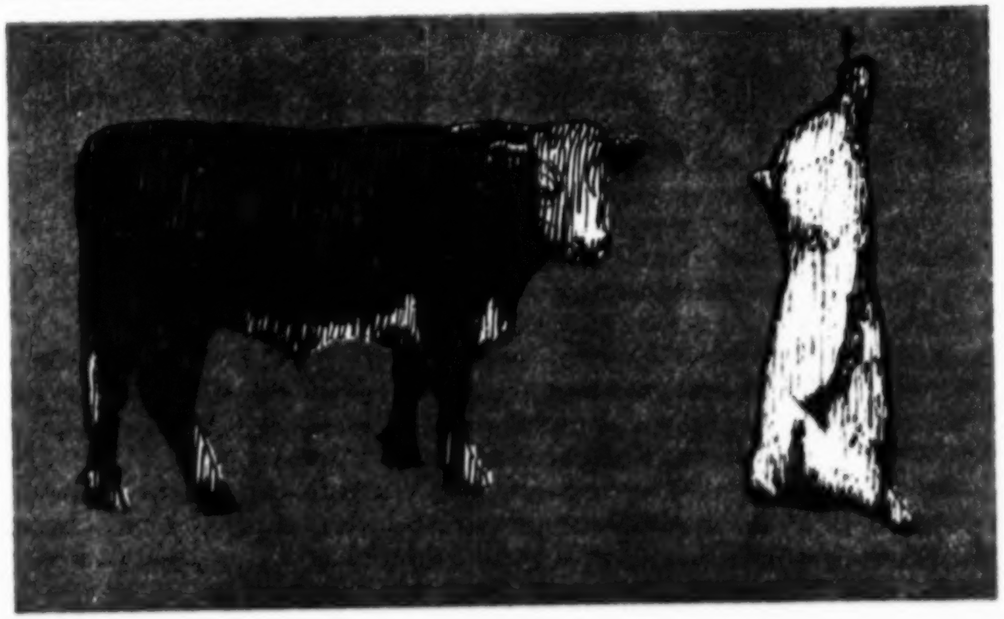
The important conformation items are structural soundness and beefiness. We look for structural traits which suggest a healthy, long-lived animal, such as correct skeletal structure. In beefiness we are looking for muscling, the thickness of the flesh. Special attention is paid to the regions of the high-priced cuts—back, loin, rump and round. We also want a satisfactory finish at a relatively young age, but animals that develop fat at the expense of muscling must be avoided, too.

Science is trying to find new tools to measure fat and muscling in live beef cattle. The near future will probably see such tools. For the present, breeders should use the best current eye appraisal methods for evaluating the major items of conformation. Some kind of scoring system is usually used to evaluate conformation. Scores are given at weaning and again at the end of the feedlot test. A scoring system may be simple, or it may involve detailed individual scores for each major conformation item.

Most performance testing programs include a method for comparing the conformation of live animals. In many programs, each animal is given an over-all index. In figuring this index, conformation is considered about equally with other traits, such as gaining ability.

Conformation is used in the selection program to guard against producing the "wrong" kind of cattle. For instance, a cow may be a good milker, but her skeletal structure may be too weak for her to have many calves. A bull may show good feed efficiency, but he may be putting on weight in the wrong places.

As an additional selection tool, progressive breeders are beginning to use carcass evaluation of some of their animals. They use carcass cutout information in addition to the visual items that can be seen in live animals. Such things as depth of fat, area of rib eye, percent hind quarters, and color of meat are considered in evaluating carcasses.



PRE QUIZ

IMPROVING A SWINE HERD

1. What is the basis of the statement "the boar is at least half the herd"?

2. What trait do you think needs most improvement in your home herd? Explain.

3. Would you agree that teats on a boar are worthless? Yes or no. Explain.

4. Selection of a boar is the main basis of a good improvement program. (True - False)

5. Name three characteristics that can be evaluated by eye.

6. Name two traits that cannot be evaluated by eye.

7. A breeder who knows his pigs can pick out the fastest gainers. (True - False)

8. Crossbreeding results in (more, less) uniform pig crop.

9. The top indexing boar in a swine testing station (may, may not) be the best boar for an individual herd.

10. Ear notching can be done any time. (True - False)

Subunit: Animal Nutrition 8 days

OBJECTIVES:

1. To appreciate the importance of the science of animal nutrition in livestock production.
2. To understand in a general way how animals convert feedstuffs into more valuable animal products.
3. To understand why balanced rations are important and how we can tell whether rations are in balance.
4. To appreciate the extent of opportunities for careers in the field of animal nutrition.

MOTIVATION:

Few areas of agriculture have benefited from research as much as the livestock industry through an increased understanding of how to feed for most efficient production. Gains in livestock feeding efficiency have increased phenomenally over the past two or three decades. Agriculturalists ought to know what's happening in the field of animal nutrition.

LESSONS:	Days	Page
1. Introducing Animal Nutrition	1	165
2. Pathways of Feed	1	173
3. Feed Nutrients	1	181
4. Digestion, Absorption, Metabolism	2	189
5. Learning About Nutrient Requirements	1	197
6. Using Nutrient Requirement Tables	2	205
	8	

GETTING READY FOR THIS SUB UNIT:

A. References and Materials
   1. Handout bearing title of each lesson
   2. Pre Quiz bearing title of each lesson

3. Movies:
Source: Communications Department
119 Whitten Hall
Columbia, Missouri 65201

		Minutes
"The Rumen Story"	Color	30
"Feeding Farm Animals"		20

4. Slides (AS65) Iowa State University, set of color slides

B. Have students bring feed tags from home for Lesson 3.

EVALUATION:

1. Give an objective test over the lessons.
2. See if students indicate an understanding of animal nutrition during the following subunit.

Lesson 1. Introducing Animal Nutrition 1 day

OBJECTIVES:

1. To understand essential differences between the digestive system of a ruminant and of a non-ruminant.
2. To understand functions of the major parts of digestive systems.

REFERENCES:

AS 65 Slides 1 - 4

	Page
Handout: "Introducing Animal Nutrition"	167
"Pre Quiz"	171

Animal Science, page 102

Livestock and Poultry Production, pages 31 - 35

MOTIVATION: Why should livestock producers know what goes on in an animal's digestive tract? Who else needs to know?

OUTLINE:

A. Parts and functions of simple digestive system
   1. Mouth
      a. Food chewed into small particles.
      b. Saliva added starting carbohydrate digestion.
   2. Esophagus
      a. Passageway to stomach
   3. Stomach
      a. Hydrochloric acid is added.
      b. Gastric enzymes added.
      c. Digestion produces some carbohydrates, protein and fats.
      d. Some absorption into bloodstream occurs.
   4. Small intestine
      a. Walls of intestine add enzymes.
      b. Bile is added from gall bladder to emulsify fats.
      c. Pancreatic juices are added.
      d. Digestion and absorption continue.
   5. Cecum
      a. Fibrous feeds are digested in horses and rabbits. Little use in most animals.

6. Large intestine
   a. Water is absorbed.
   b. Some bacterial digestion and some absorption occurs.
7. Anus
   a. Passageway to expel undigested portions of feed.

B. Ruminant variation of stomach (cattle, sheep, goats)
   1. Rumen (paunch)
      and
   2. Reticulum (honeycomb)
      a. These two store up to 60 gallons of feed.
      b. Food is agitated, fermented and digested by bacteria.
      c. Food is broken into smaller particles. Saliva and water are added to aid digestion.
   3. Omasum (Many plies)
      a. Grinds food
      b. Squeezes out water
   4. Abomasum (True stomach)
      a. Digestive juices are added.
      b. Functions similar to simple stomach.

PROCEDURES:

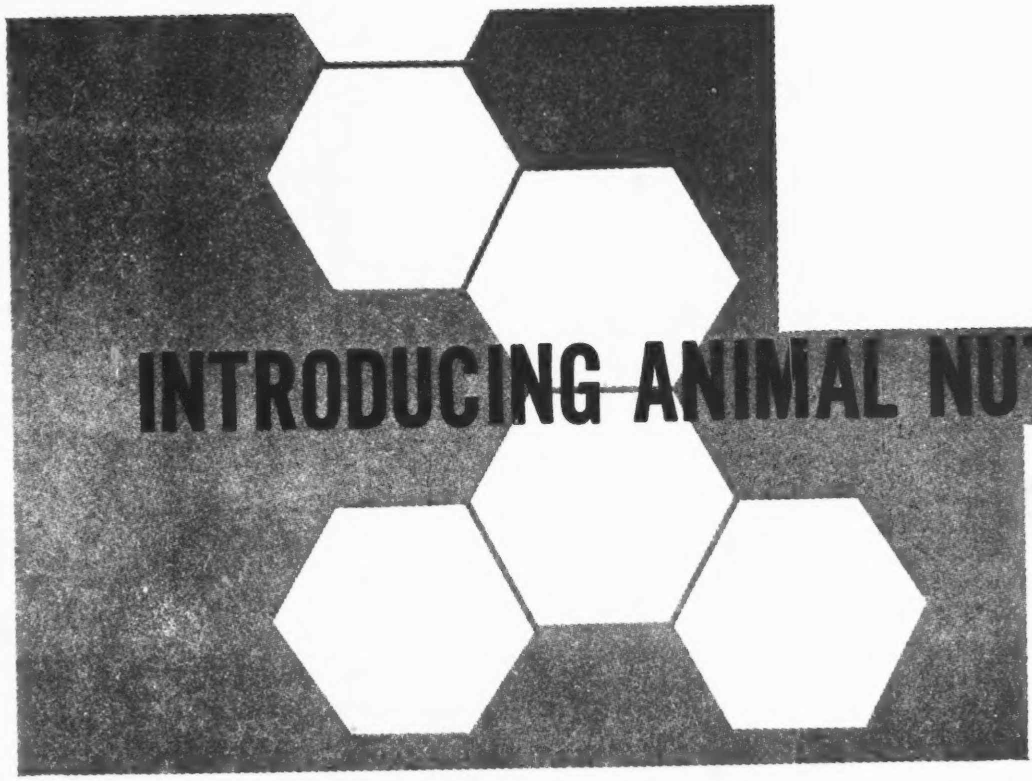
1. Give the Pre Quiz.

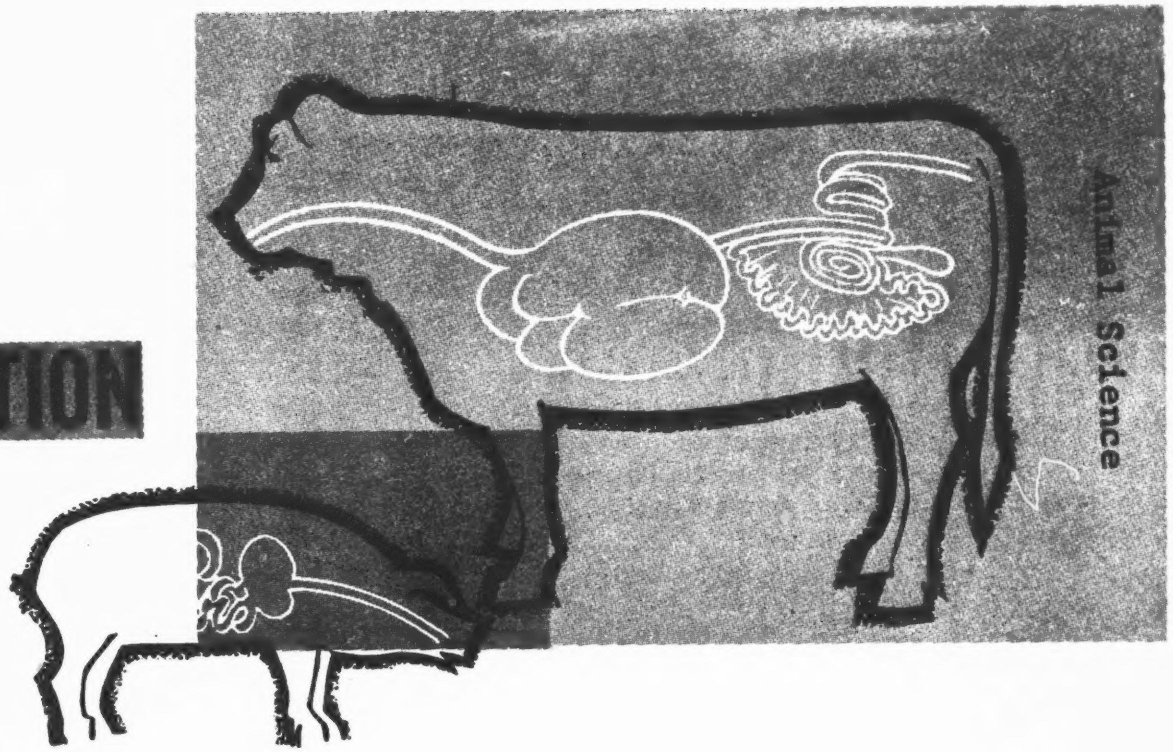
2. Show the AS slides.

3. Discuss questions in the Pre Quiz.

SUMMARY:

INTRODUCING ANIMAL NUTRITION





Something amazing happens when you feed your pig or calf. Forage is turned into beef. Grain becomes pork. A quiet-looking scoop of grain becomes bursting energy as a calf romps in the feedlot.

You feed your animal every day. It is something you do automatically, probably without thinking about what you are really doing. You are giving your animal the energy it needs to move around and to fatten. You are giving it needed vitamins and minerals to keep healthy. You are giving it the "building blocks" of protein to grow. When the animal is grown, the feed you give it will help it reproduce and provide milk for its young.

In other words, you are giving your animal nutrients. You are part of the world of animal nutrition.

Animal nutrition is a science. It is the science of all the processes which take place when feed is given to animals.

Chemistry is very important in animal nutrition. Biochemistry—the chemistry of life—is largely involved.

The feed you give your animal is made up of various combinations of chemical substances. After the feed is eaten, more materials are added to it by the animal's body. These materials bring about reactions which break the feed down into very small particles—so small they cannot be seen by the naked eye.

These particles are then taken into the blood stream, where they are carried to all parts of the body. Here the particles are "burned" for energy, form body tissue, or are stored as energy in the form of fat.

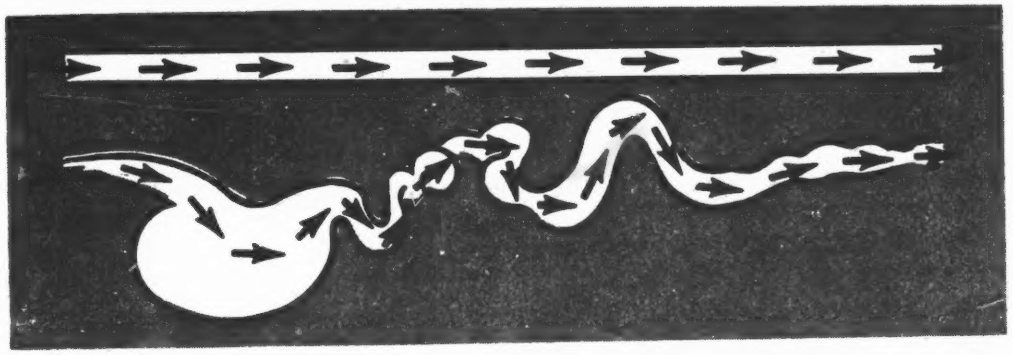
These first reactions—where the food is broken down—are called digestion. Digestion takes place in a special system called the digestive tract. This tract begins with the mouth and teeth, where food is broken into fine particles by chewing. The mouth is connected to the stomach by the esophagus. The stomach empties through a valve into the small intestine. The small intestine empties into the large intestine, which terminates at the anus.

Source: Dr. T. W. Wickersham, Extension Animal Scientist, Iowa State University

The Digestive "Factory"

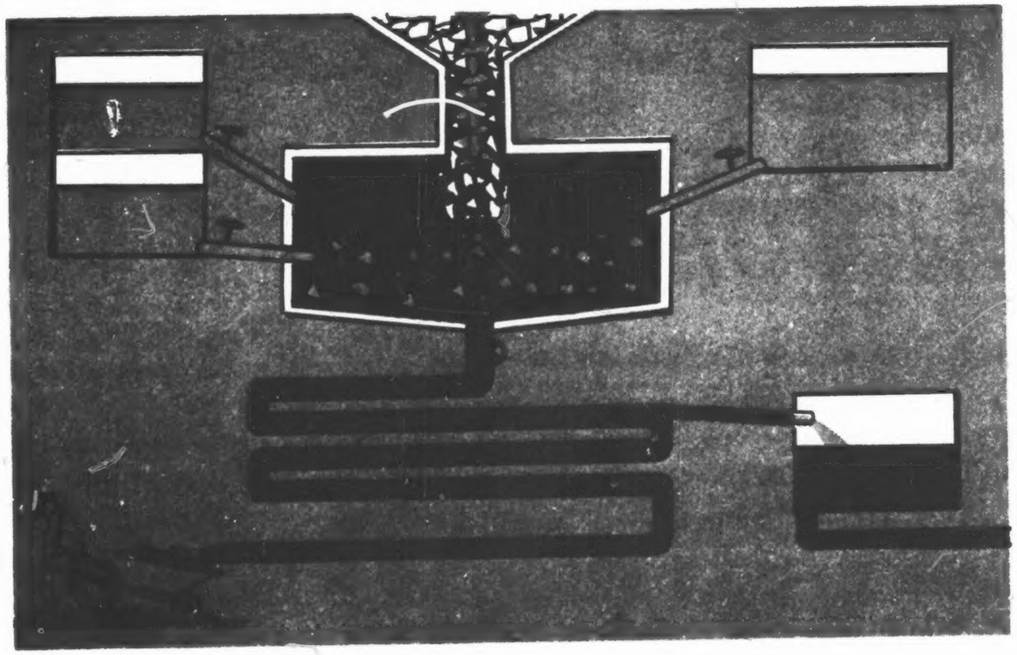
Think of the digestive tract (or gastrointestinal tract) as a hollow tube.

The digestive tract is like an assembly line; but instead of building something, this factory takes something apart. Food entering the mouth is broken down by the teeth. As it passes through the rest of the tract, the chewed feed is gradually broken down into smaller and smaller units.



There are four main parts of the digestive tract where chemical reactions take place. In each chamber, different chemicals— digestive juices—are added to the food. These will be explained in detail later.

The job of the digestive tract is the same in all animals. But there are important differences in the digestive tracts of different animals. Cattle are fed much hay or other materials high in fibers. Pigs are fed grain or other materials low in fiber. The reason for this is that cattle are able to more efficiently digest fibrous materials than pigs. The differences in the digestive tracts of cattle and pigs largely explain this.



Through the Digestive Tract

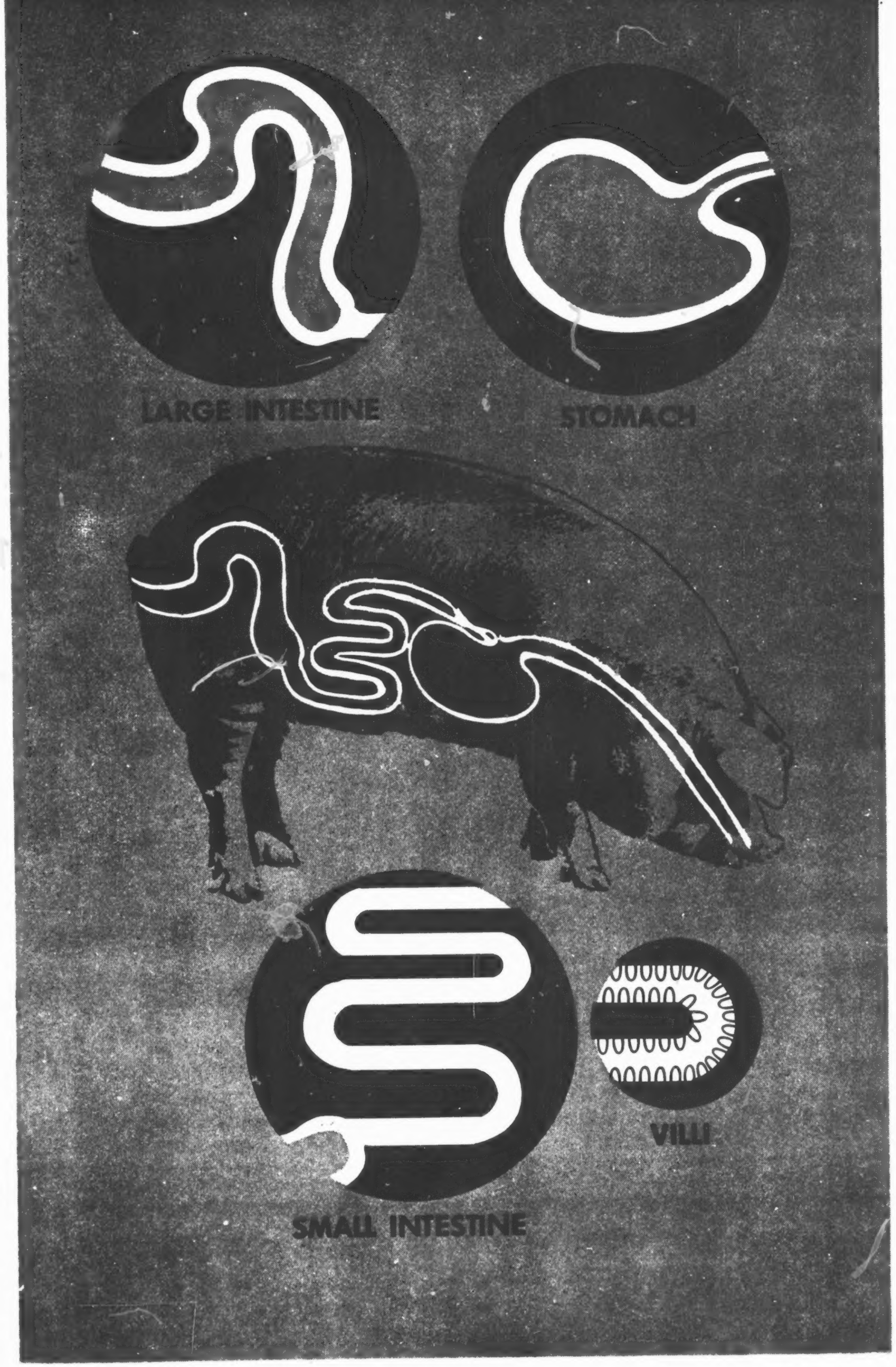
The first part of the tract is the *mouth.* This, of course, is the place where food enters the digestive tract and where the food is broken into small particles by the teeth. In pigs an enzyme is added by the saliva in the mouth to start carbohydrate digestion. Digestion of food by man starts in the mouth too. The second part of the digestive tract is the *esophagus.* It is a tube which carries food from the mouth to the stomach. A series of muscle contractions move the food through the digestive system. The first of these is referred to as swallowing and is responsible for moving food from the mouth to the stomach. (This works about like pinching toothpaste out of a tube.)

The *stomach* is the first reaction chamber. It is a kind of vat where chemicals are added to the food. Certain cells of the stomach wall produce hydrochloric acid. Other cells secrete gastric (stomach) enzymes.

The stomach is where carbohydrate and protein digestion gets underway and fat digestion starts (except in ruminant animals). Digestion produces very small particles of protein, carbohydrates and fats. Some of these pass through the stomach wall into the blood stream. Food which the stomach is not designed to completely digest and absorb passes on to the small intestine.

Food from the stomach passes through a valve into the *small intestine,* which is the next chamber. The intestine is a very complex tube which lies in a spiral. In some animals, it is 130 feet long. Digestion and absorption continues in the small intestine, where more digestive juices are added. The cells lining the walls of the small intestine produce enzymes that aid digestion as well as absorb the digested feedstuff. In addition, two important glands deposit their juices in the small intestine. The first of these is the *liver.* The bile duct runs from the gall bladder (which is closely associated with the liver) to the small intestine. Through it pass bile secretions. These react with fats to help digest them. The second gland is the *pancreas.* Through the pancreatic duct, it delivers several digestive juices to the small intestine. These juices help digest several food components, including carbohydrates, fats and protein. More food-nutrients are absorbed from the small intestine than from any other organ.

A "blind gut" called a caecum is found at the junction of the small and large intestine. In most animals, the caecum is small and has little function. But it is very important in some animals such as horses and rabbits. In these animals fibrous feeds are digested in the caecum.


LARGE INTESTINE
STOMACH
SMALL INTESTINE
VILLI

The next part of the digestive tract is the *large intestine.* It is the fourth major part of the tract. This intestine is shorter but larger than the small intestine. Its main function is to absorb water. It is also the site of some bacterial digestion, as in the caecum. Another job of the large intestine is to add mucus material to the remaining food. This is a lubricant that makes passage through the tract easier. Just as in the small intestine, muscle contractions move the food.

The last part of the digestive tract is the *anus.* It is simply an opening through which the undigested portion of the feed taken in at the mouth is eliminated.

So this is our "hollow tube." Its main job is to digest and absorb food.

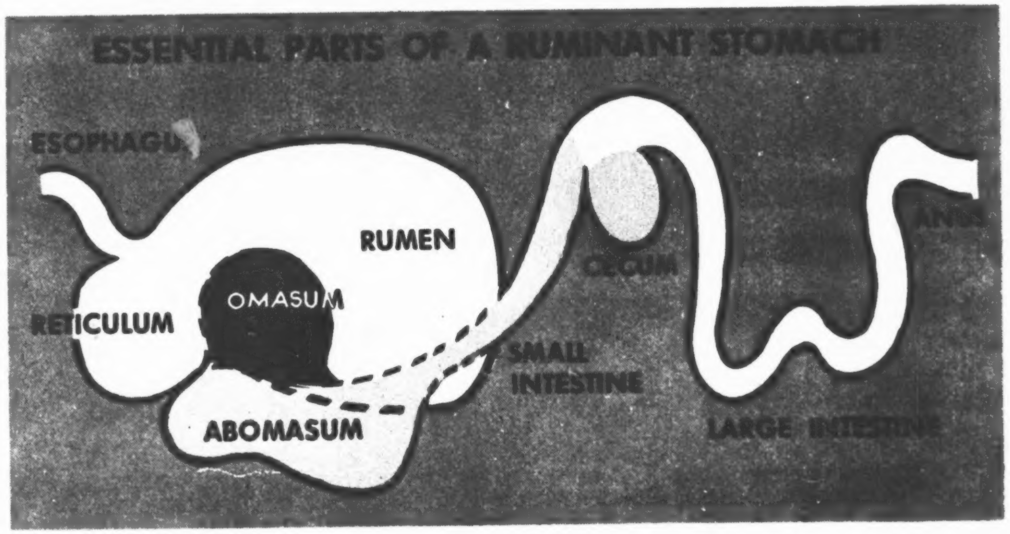
Cattle Have Special Stomachs

We mentioned that cattle can digest large quantities of fiber while pigs cannot. How do cattle digest roughage?

The answer lies in the cow's special kind of stomach.

Cattle are ruminants. This means they have compound stomachs. Sheep, goats, deer and many other grazing animals are also ruminants.

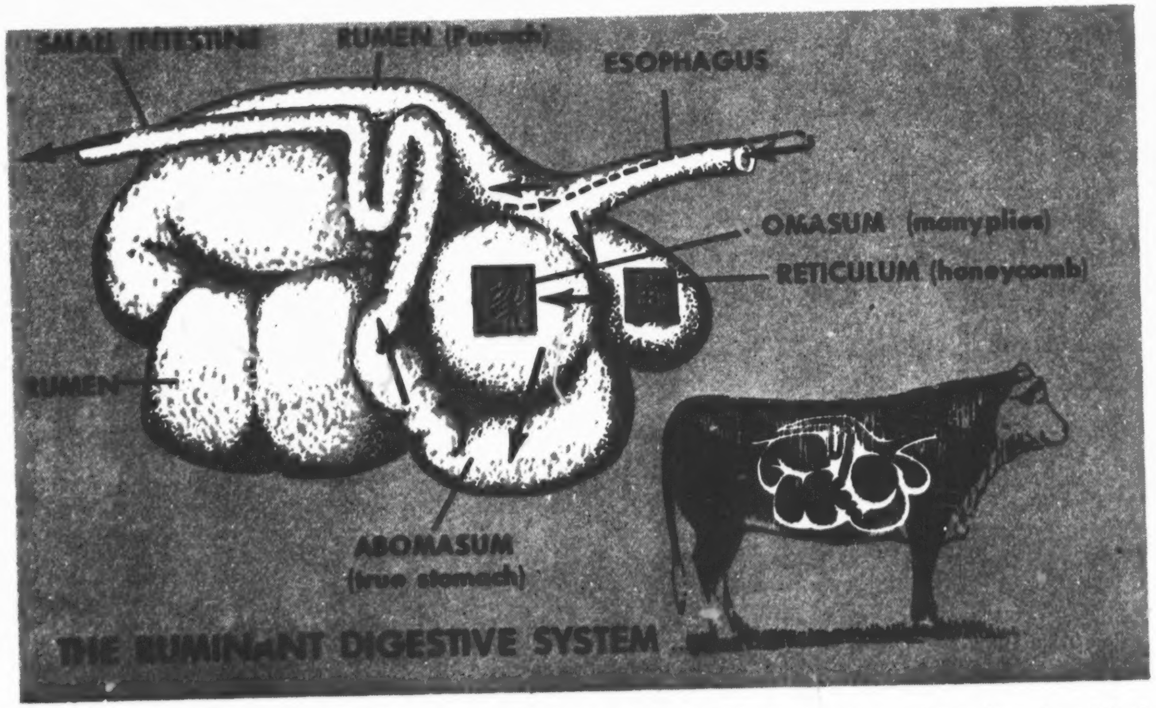
A ruminant animal's stomach has four compartments. The first compartment is the *rumen* or paunch. Next is the *reticulum* (reh-tik-u-lum) or honeycomb. There is no division between the rumen and reticulum. They are generally thought of as one compartment. In the adult cow,


ESSENTIAL PARTS OF A RUMINANT STOMACH
ESOPHAGUS
RUMEN
RETICULUM
OMASUM
ABOMASUM
CECUM
SMALL INTESTINE
LARGE INTESTINE
ANUS

the rumen and reticulum can hold 40 to 60 gallons of feed material. They almost completely fill out the left side of the middle part of the animal.

The rumen and reticulum make up a huge "vat." In it, food is agitated, fermented and digested. Many bacteria and protozoa are found in these two compartments. The feeds high in fiber (roughage) eaten by cattle [illegible] digested in the rumen and reticulum with the help of these bacteria. (Bacteria and protozoa are really small animals.)

This is not the only job of the rumen and reticulum. Muscle movements in the two compartments help break up food into smaller particles so bacteria and protozoa can do their job better. Also, digestion is aided in these compartments by the addition of much saliva and water.



THE RUMINANT DIGESTIVE SYSTEM

The third compartment of the ruminant stomach is the *omasum* (o-may-sum) or manyplies. It makes up about 8 percent of the stomach. Scientists do not yet know the exact role of the omasum. For one thing, it acts to grind up food. But just how much grinding it does is uncertain. The omasum may also squeeze water out of food that has come from the rumen.

The fourth compartment is the *abomasum* (ab-o-may-sum) or "true stomach." It is about the same size as the omasum. This is the only compartment of the stomach where digestive juices are produced. It works similarly to the stomach in nonruminant animals such as the pig. From the abomasum on, the ruminant digestive tract is the same as the nonruminant tract.

Together, the omasum and abomasum make up about one-fifth of the adult ruminant's stomach. They are mostly on the right side of the animal.

A FEW NUTRITION TERMS

DIGESTION (di-jes´-chun) is the process which breaks down food before it is absorbed from the G. I. tract into the body. It includes all the activities of the digestive tract and its glands.

METABOLISM (meh-tab´-o-liz'm) concerns food after it has been digested. It is the changes which take place in digested food after it has been absorbed from the digestive tract. In metabolism body tissue is built and energy is used.

RUMINANTS (roo-mi-nants) are animals with more than one compartment in their stomachs. They are sometimes thought of as having four stomachs. Cattle and sheep are ruminants. Only ruminants chew a "cud."

NONRUMINANTS are animals that have one stomach. Pigs and horses are nonruminants.

ENZYMES (en´-zimes) are digestive juices which act as catalysts. They speed up chemical reactions in digestion.

MECHANICAL FACTORS in digestion include chewing and swallowing. Regurgitating the "cud" and muscle action in the stomach and intestines are other mechanical factors.

SECRETORY FACTORS (see´-kre-to-ri) have to do with glands. Glands do not act directly in digestion. They secrete enzymes to help digestion.

CHEMICAL FACTORS are chemicals that aid digestion. They include both enzymes and other chemicals. Hydrochloric acid is one of the others.

MICROBIAL FACTORS (mi-kro-bi-al) are bacteria that play a part in digestion. Sometimes protozoa (one-celled animals) are also involved.

PRE QUIZ

INTRODUCING ANIMAL NUTRITION

1. Which animal, the pig or calf, has a digestive tract more nearly like yours?

2. On which side, the right or left, would you stick a bloated calf? Why?

3. What is the first use made of feed by the animal?

4. Do cattle have four stomachs or four compartments of one stomach?

5. The digestive tracts of cattle and pigs are similar from the true stomach on through the tract. (True - False)

6. "Nutrition" and "feeding" mean the same thing. (True - False)

7. There is no particular reason that cattle can utilize more fibrous feed than hogs. (True - False)

8. The small intestine has (more, less) important functions to perform than the large intestine.

9. The digestive systems of horses and rabbits are alike in what respect?

10. Hogs have a more complex digestive tract than cattle. (True - False) Explain.

Lesson 2. Pathways of Feed 1 day

OBJECTIVES:

1. To understand how feeds pass through the digestive tracts of cattle and hogs.

2. To understand rumination in cattle.

REFERENCES:

AS 65 Slides (5 - 11)

		Page
Handouts:	"Pathways of Feed"	175
	"Pre Quiz"	179

Movies: "The Rumen Story"
"The Gastric Fistula Technique"

MOTIVATION:

How do you suppose scientists found out what goes on inside a cow's stomach? Would you like to know? Show one of the movies.

OUTLINE:

A. Ruminant Pathways
  1. Route of ground concentrate or cud
  2. Route of light, bulky grain
  3. Route of forage or roughage

B. Mechanical Factors
  1. Chewing
  2. Swallowing
  3. Rumination (Reticulum pump action)
  4. Continual mixing with water and recirculation between rumen and reticulum.
  5. Squeezing out water by abomasum
  6. Muscular contractions forcing feed through the system.

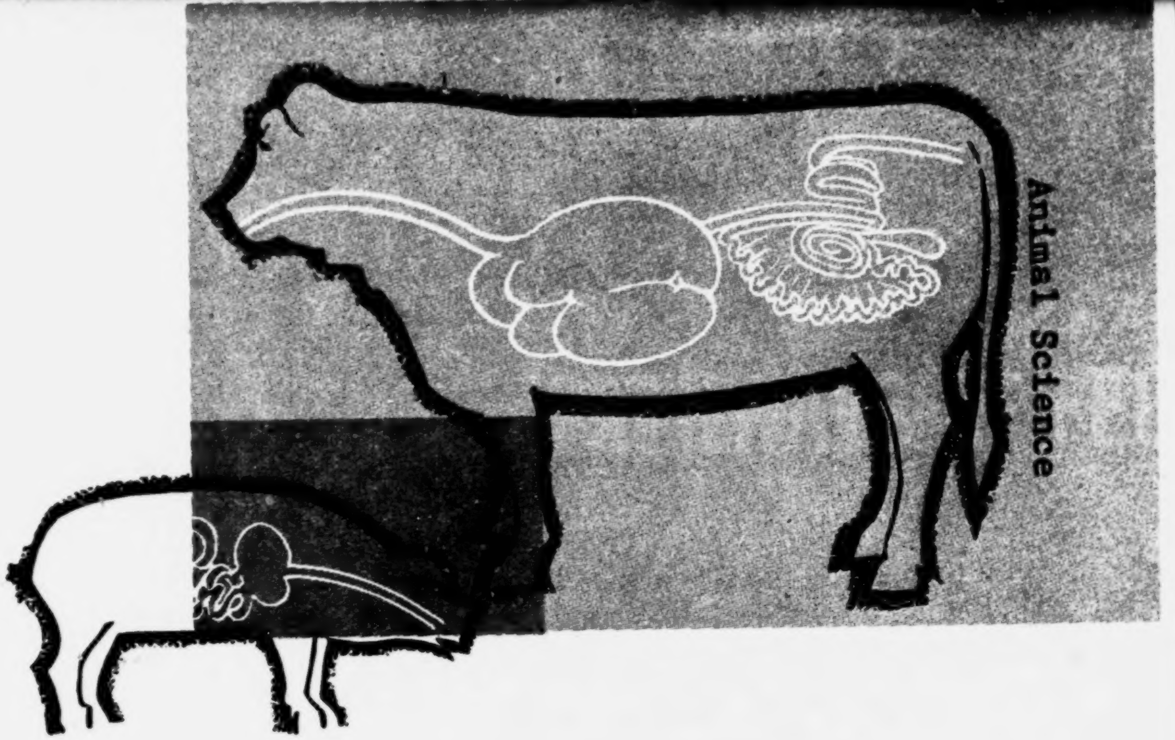
C. Nonruminant Pathways

PROCEDURES:

1. Give Pre Quiz.
2. Show one of the movies.
3. Use the AS 65 slides to illustrate concepts in the outline.
4. Compare the rate of digestion by cattle and hogs.
5. Discuss the Pre Quiz.

SUMMARY:

PATHWAYS OF FEED



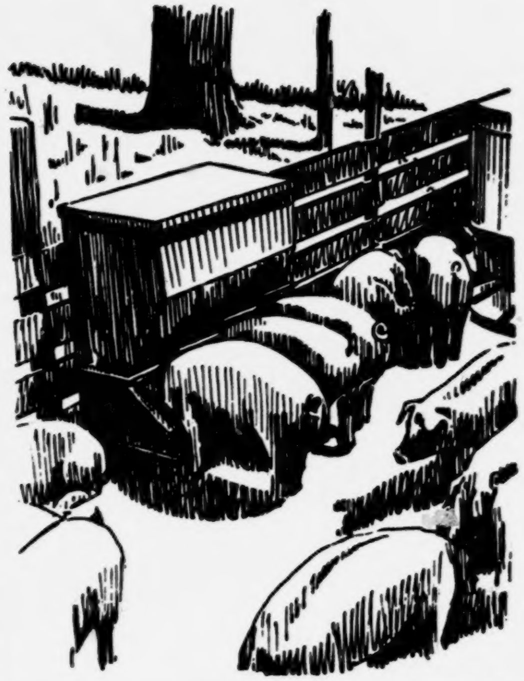
A shady pasture dotted with resting cattle looks like a quiet scene indeed. Cattle leisurely chewing their cud are the picture of ease.

But beneath this calm surface is a bustle of activity. In a huge vat inside the cattle, feed is being mixed, ground up, moistened and fermented. Bacteria in this vat are breaking down feed. The muscles of the digestive organs are contracting and expanding.

Digestion is underway.

Digestion is a complex chemical process. But much more than chemistry is involved. Muscle actions of the digestive tract and the different routes which feed takes through the digestive tract are also important.

Cattle are ruminants. Pigs are nonruminants. As a result, the pathways of feed in these animals are different. This, in turn, affects their nutrition.



Source: Dr. T. W. Wickersham, Extension Animal Scientist, Iowa State University

Pathways in Ruminants

Differences in the digestive tracts of cattle and pigs are reflected in the ways they eat.

You can watch cattle use their strong tongues to pull in great amounts of feed. They eat rapidly, seldom pausing and hardly bothering to chew. In fact, they eat so hurriedly that they sometimes swallow nails, wire, glass or other debris left around the farm. This is why ruminants sometimes get "hardware disease."

No matter what kind of feed is being eaten, cattle only partially chew it. Only about half the whole-kernel corn eaten by cattle is crushed before it is swallowed. This is why you will often find undigested corn in cattle manure.

After cattle have taken in enough feed to fill their rumen, they usually find a comfortable spot to lie while they "chew their cud." The feed in the rumen is hardly changed from the form in which it was swallowed except that water has been added. The rumen and reticulum work to prepare the feed for digestion.

The rumen and reticulum act as a holding vat. Feed is stored here for several hours while bacteria digest the feed. Meanwhile, much of the coarse feed is regurgitated into the animal's mouth for rechewing.

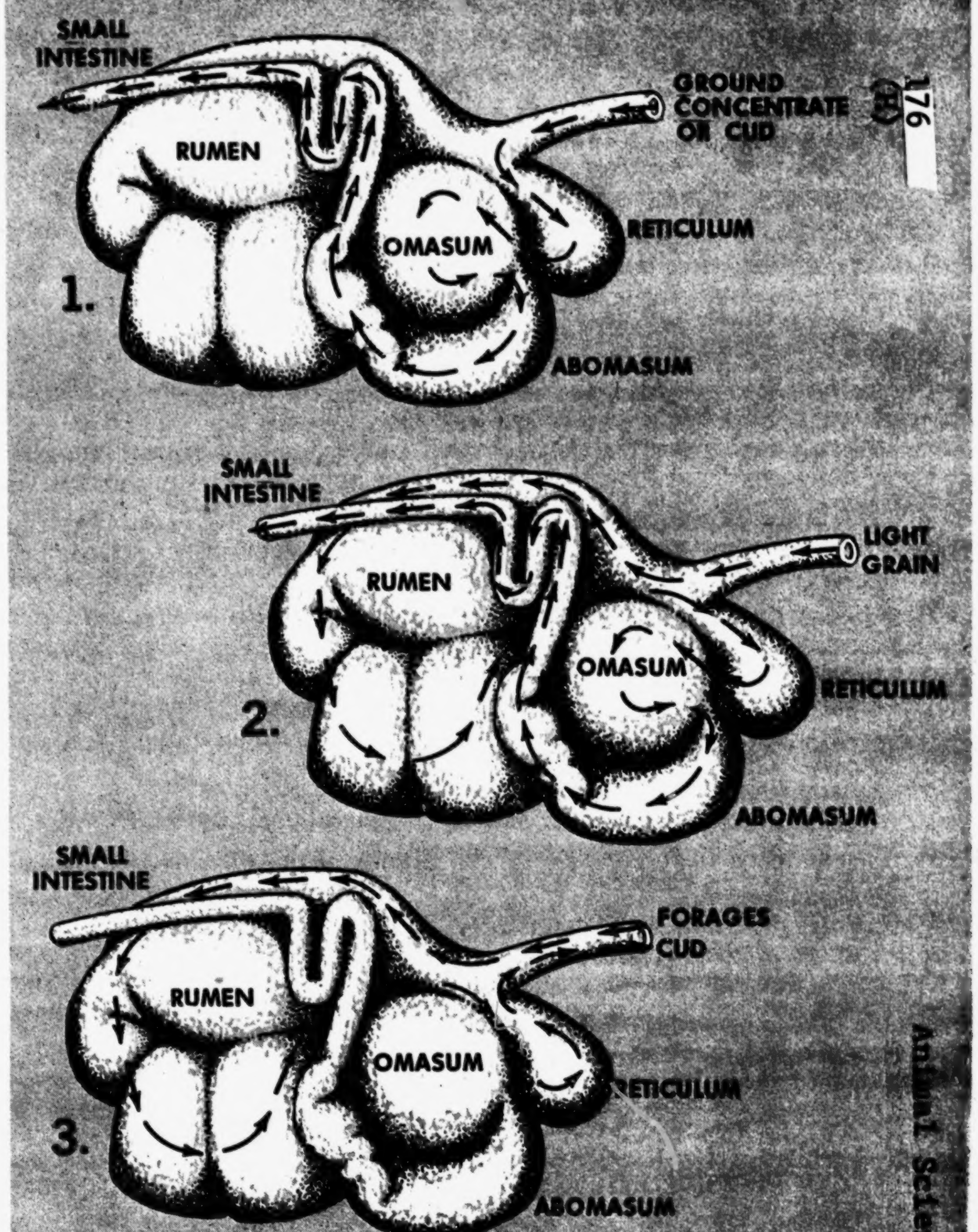
The exact route followed by feed during this process is not always the same. The route taken by the feed depends upon what kind of feed it is. There are three possible routes:

1. The most direct route is from the esophagus to the reticulum into the omasum. This is the route of ground concentrate and "heavy" feed. From the omasum, feed enters the abomasum. From there it passes through the small intestine, the large intestine and is then eliminated through the anus as waste.

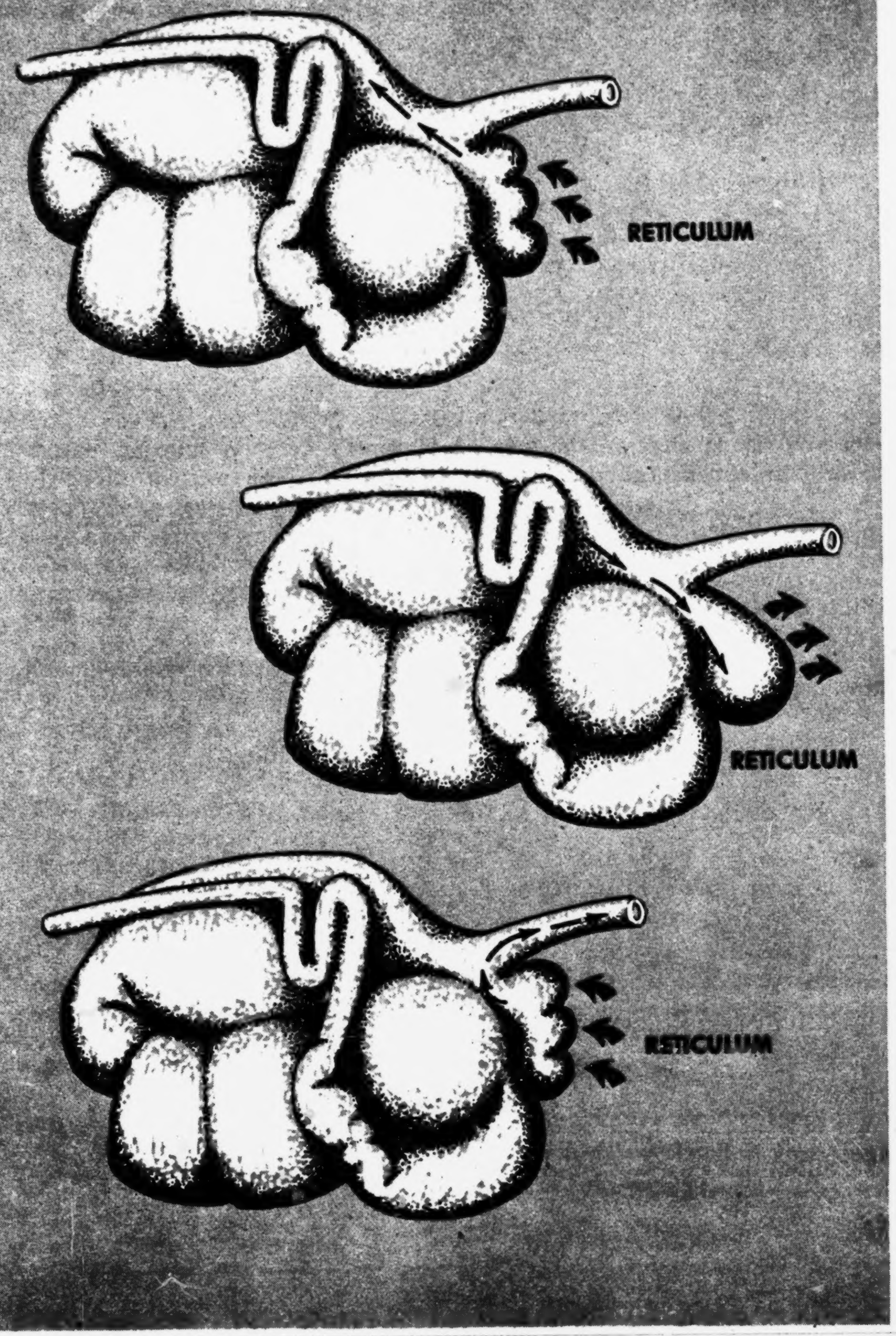
2. Food may be flushed into the back of the rumen. After traveling around the rumen, it enters the reticulum and passes on to the omasum. From there it enters the abomasum.

3. The feed may complete the circuit of the rumen. After entering the reticulum, it is regurgitated as a cud. It is rechewed and swallowed again. The feed may then follow either route 1 or route 2.

THREE POSSIBLE ROUTES OF FEED IN RUMINANTS



IN RUMINATION, THE RETICULUM ACTS AS A PUMP



Mechanical Factors

Liquids constantly circulate between the rumen and reticulum. This helps digestion by keeping the feed in these compartments moist. It is one of the *mechanical factors* in digestion.

Stirring a cup of coffee causes the sugar to dissolve more quickly than if it is not stirred. Mechanical factors of digestion work the same way. They help the chemical reactions in digestion.

Chemistry is very important in digestion. Chemical reactions break down feed so it can be absorbed. But we sometimes overlook mechanical factors. They are also important.

The first mechanical factor is chewing, which is followed by swallowing. In cattle, rumination—the process in which the cud is chewed—comes next.

Rumination in cattle begins about an hour after eating. It continues for about 45 minutes. Feed is regurgitated and rechewed. Saliva is added, and the feed is reswallowed.

During rumination, the reticulum acts as a sort of pump. At the beginning of rumination it contracts. This forces feed in the reticulum upward and backward into the rumen. When the reticulum relaxes again, it fills up with feed that has been fermenting in the rumen.

Then the reticulum contracts again to trap another supply of food stuffs for rechewing. This food is forced up the esophagus into the mouth. The process is aided by gas and muscle pressure in the rumen.

The first contraction of the reticulum takes about 1 minute. The second contraction is stronger, but it lasts only about half as long.

Cattle usually have six to eight rumination periods each day. A total of 5 to 7 hours is spent in rumination. About 90 to 130 pounds of feed is regurgitated and rechewed daily.

Dry feed, such as grass or hay, MUST be ruminated. It cannot be digested otherwise. Most of the grains do not appear in the cud. They probably pass straight to the abomasum (true stomach), since they do not require rechewing and do not require long exposure to the more powerful forces of digestion at work in the rumen.

Slow Feed Passage in Cattle

After the cud is rechewed it is reswallowed .and passes down the esophagus into the reticulum. Most of it then goes on to the omasum. When the omasum contracts, water is squeezed out while the feed is being forced into the abomasum.

As the feed continues through the digestive tract, there are more mechanical factors involved. Most of them are muscle contractions in the digestive organs which push feed along the tract.

The appetite of cattle depends somewhat on how much feed is left in the digestive tract. Animals fed an easily digested feed (such as ground corn) have better appetites than animals fed hard-to-digest feeds (such as hay). This is because the easily digested feeds pass through the tract more quickly and leave the tract empty. The empty tract stimulates appetite.

In a normal ration, these are the times it takes feed to pass through each compartment in the digestive tract of cattle:

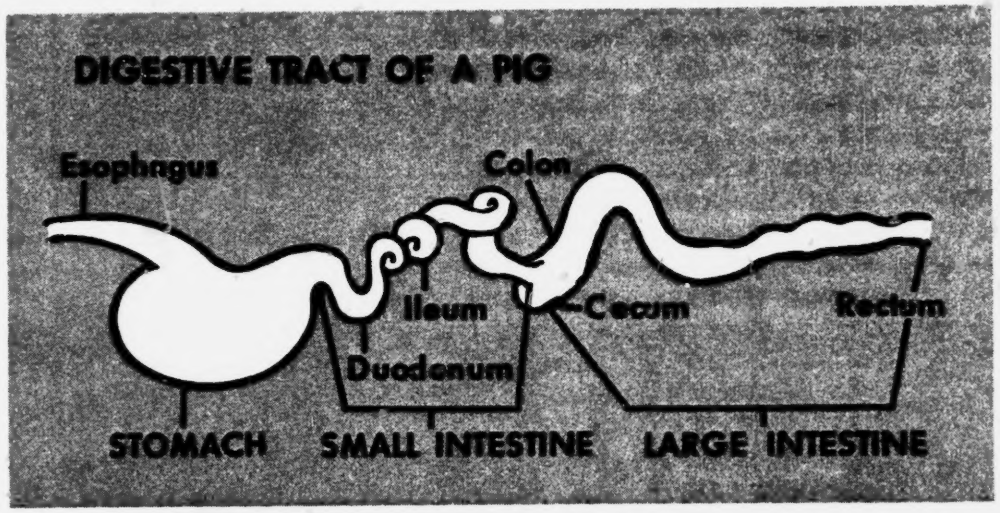
Rumen and reticulum	61 hours
Omasum	8 hours
Abomasum	3 hours
Small intestine	7 hours
Large intestine	8 hours

That's a total of almost 4 days for feed to pass through cattle. With some portions of the diet the time is even longer.

Pathways in Nonruminants

Compared with the time required for cattle, the 24 hours required for feed to pass through the digestive tract of a pig is short.

Pigs do not have a rumen where feed can be stored while it is digested. Neither do they ruminate or chew a cud. Pigs must chew their feed for good digestion before it is swallowed, or the feed must be ground for them. Another reason pigs chew and swallow slowly is to get feed mixed with an enzyme in the mouth.



From the mouth feed passes down the esophagus into the stomach. From there it passes through the small and large intestines.

From this comparison, we can see why ruminants are well suited for digesting large amounts of roughages. The rumen acts as a storage vat while digestion is carried on by bacteria. Feed passes through the tract slowly. This allows plenty of time for digestion of tough roughages.

PRE QUIZ

PATHWAYS OF FEED

1. The pig gets hardware disease. (True - False)
2. Feed stays in the digestive tract about (2, 3, 4, 10) times as long in cattle as hogs.
3. All feed is rechewed by cattle. (True - False)
4. Cattle chew the cud more on high grain-low roughage rations. (True - False)
5. Is feed ground for the same reasons for pigs and cattle? (Yes - No)
6. The steer on a fattening ration has a better appetite than one on an all-silage ration. (True - False)
7. What happens when a steer "loses his cud"?
8. Does the pig or the steer have the more muscular digestive tract?
9. Some coarse hay might still be in the digestive tract of a steer (12 hours, 1, 3, 5, 7 days) after it is eaten.
10. A well-balanced, good-quality, complete grower ration might still be in the digestive tract of a pig (12 hours, 1, 3, 5, 7 days) after it is eaten.
11. Steers and pigs both vomit. (True - False)

Lesson 3. Feed Nutrients 1 day

OBJECTIVES:

1. To discover the kinds of nutrients needed.
2. To increase knowledge of what each nutrient's functions are.
3. To have a general understanding of how feeds are analyzed for nutrient content.

REFERENCES:

AS 65 Slides 12 - 18

		Page
Handouts:	"Feed Nutrients"	183
	"Pre Quiz"	187

MOTIVATION:

Give the Pre Quiz.

OUTLINE:

A. Kinds of Nutrients
  1. The Energy Nutrients (C, H, O)
    a. Carbohydrates
      (1) Sugars
      (2) Starches
      (3) Cellulose (fiber)
    b. Fats and oils
      (1) 2¼ x as much energy per pound as carbohydrates
      (2) Alike except for melting point
  2. The Proteins (C, H, O, N)
    a. Made up of amino acids
    b. Essential for making body tissue
  3. The Vitamins (Organic and essential for life)
    a. A - Green grass
    b. D - Sunshine
    c. Others
  4. The Minerals (Inorganic and essential for life)
    a. Examples
      (1) Iron
      (2) Copper
      (3) Phosphorous
      (4) Calcium
      (5) Magnesium
    b. Deficiencies cause nutritional diseases, improper bone and tooth formation etc.

    5. Water
        a. Largest part of most living things
        b. Essential for body functions

B. Analyzing Feeds
    1. Heat above 212° F. to remove water and determine dry matter.
    2. Burn to remove organic matter and determine ash.
    3. Chemically determine N and multiply by 6¼ to determine protein.
    4. Heat in ether several hours. Evaporate ether from extract to determine fat.
    5. Dissolve feed in weak acid or alkali. Residue will be fiber.
    6. Add water, ash, protein, fat and fiber. Subtract from 100% to determine NFE.

PROCEDURES:

1. Give pre quiz.

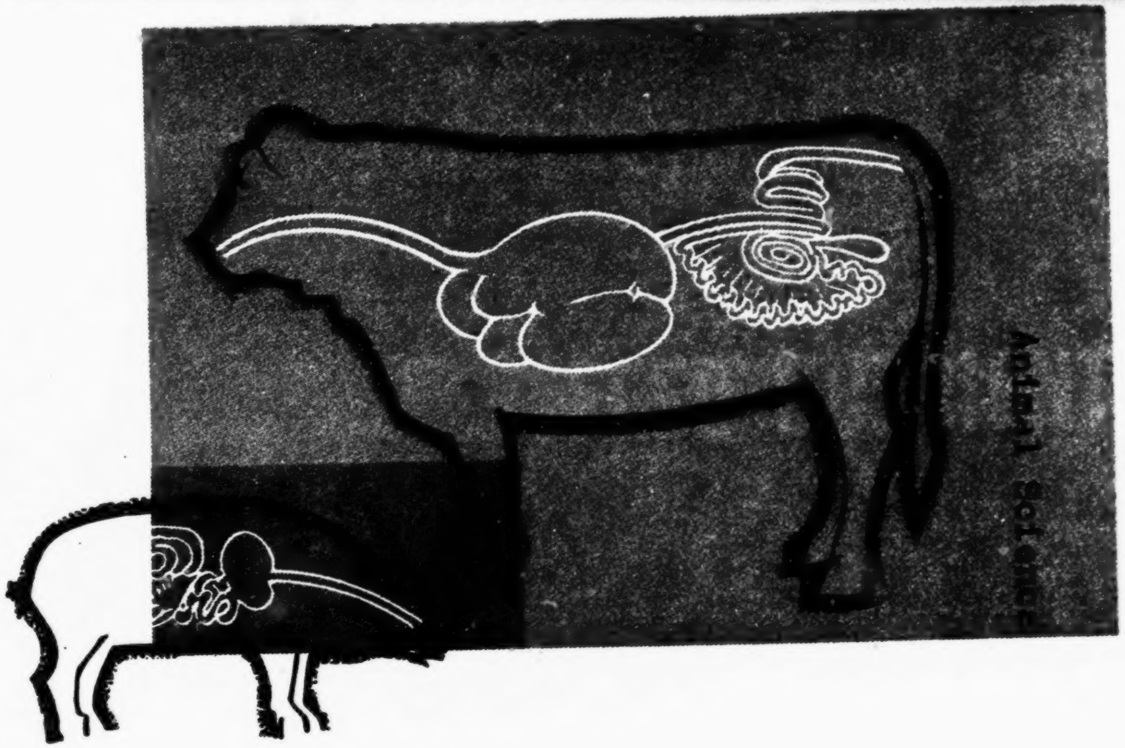
2. List the five kinds of nutrients. Discuss variations in requirements, quality in protein and other items in the outline.

3. Show slides and discuss items in the outline.

4. Discuss the Pre Quiz.

SUMMARY:

FEED NUTRIENTS



You probably feed your animal a supplement. If your project is a calf, you feed one kind of supplement. If it is a pig, you feed another kind, and so on.

You know that the supplement will make your animal grow faster and make more economical gains. The animal will be in "better shape" than if you just let it root or graze.

You know this because you know something about animal nutrition. Animals need many different kinds of nutrients. Different animals need different kinds and amounts-of nutrients. This is where the science of animal nutrition comes in. Part of the animal nutritionist's job is to find out what nutrients animals need.

In feeding experiments, different feed ingredients are tried. In the laboratory, feeds are analyzed. Nutritionists search for the best combination of feeds for the kind of animal being fed. For dairy cows the feed must help produce lots of milk. For a brood sow the feed is designed to help produce healthy litters. For a steer, fast gains at the least cost are desired.

After experiments are conducted, they are checked and rechecked. Then the results are used to make recommendations to farmers. This means more profit for the farmer. It means better, cheaper meat and meat products for everybody.

Kinds of Nutrients

There are many different chemicals in feeds. Animals need some of them in large amounts— others are needed only in tiny amounts. Some haven't been discovered or named yet.

These feed constituents are divided into five main types of nutrients. Each type has a different job in the animal's body. The five types are (1) energy nutrients, (2) proteins, (3) vitamins, (4) minerals and (5) water.

None of these is more important than the others. All are essential. But with the exception of water, the energy nutrients usually make up the greatest bulk of feed.

Source: Dr. T. W. Wickersham, Extension Animal Scientist, Iowa State University

Energy nutrients are the body's fuel. In fact, they are even chemically similar to fuels we use—gasoline, oil and coal.

After digestion, the energy nutrients are carried by the blood to the cells of the body. In reactions very much like burning, they are used by the cells for energy. Energy or fuel is required to power the movements of muscles—walking, a beating heart, breathing, blinking eyes, contractions of the digestive system. At the same time, heat is produced to maintain body warmth.

The main energy nutrients are *carbohydrates.* There are many carbohydrates. Even the relatively simple ones are complex compounds. All carbohydrates are made up of carbon, hydrogen and oxygen. Carbon is the key to carbohydrates. This element can behave in several different ways. As a result, there are thousands of possible combinations of carbon, hydrogen and oxygen.

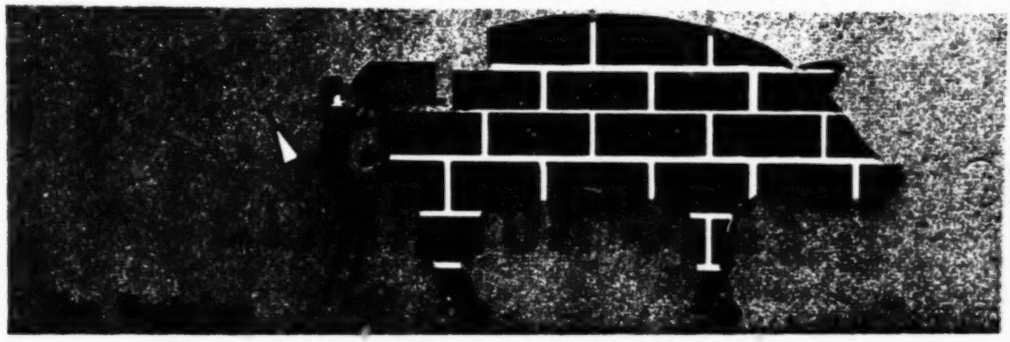
Sugars and starches are carbohydrates. They are relatively simple. Cellulose is one of the more complex carbohydrates.

The sugars and starch are easy to digest. They have a high "feeding value" because very little of them pass through the body undigested. Grains such as corn and oats contain much sugar and starch.

Cellulose is chemically a carbohydrate. It makes up the fiber in plants. Grass has much cellulose. Cellulose is hard to digest. For most animals it has a low feeding value; however, ruminants can digest large amounts of cellulose with the aid of bacteria in the rumen.

Another group of energy nutrients is the *fats* and *oils.* Fats and oils are chemically alike. Their main difference is that fats are solid at body temperature; oils are liquid. Both are usually called *fats.*

Like carbohydrates, fats are made up of carbon, hydrogen and oxygen. They are also used to provide energy for movement and heat. Fats contain a higher percentage of carbon and hydrogen atoms than carbohydrates do. So the energy in fats is more concentrated. Fat has 2.25 times more energy value than carbohydrate.

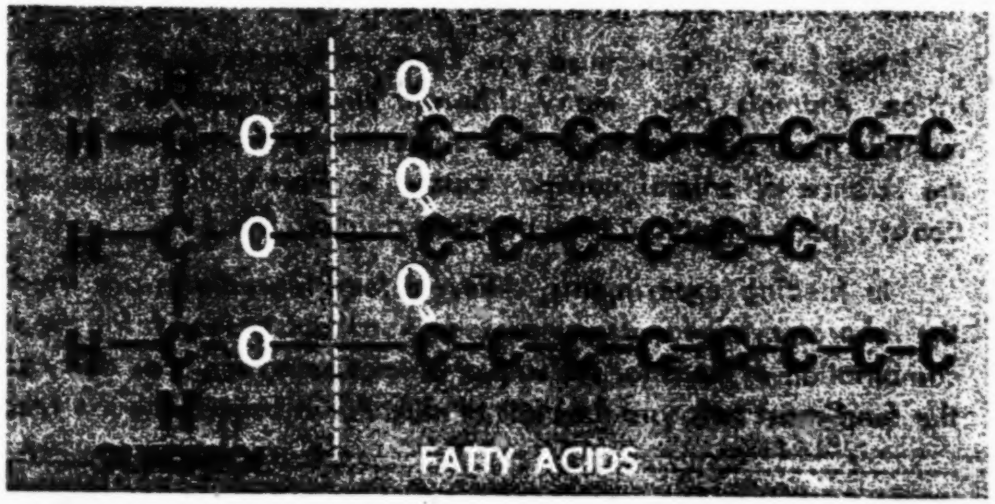


While carbohydrates and fats supply energy, *proteins* supply the material from which body tissue is made. They are the bricks and mortar from which bodies are built.

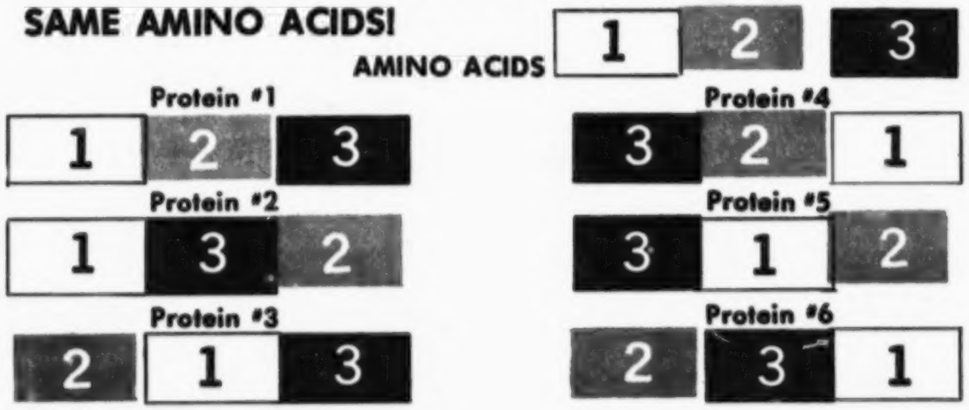
Proteins are highly complex. In addition to carbon, hydrogen and oxygen, they contain nitrogen. Some proteins also contain sulfur. A few contain phosphorus or iron.

Like carbon, nitrogen can be combined with other chemical elements in different ways. The various combinations result in many different proteins. Each protein is made up of several nitrogen compounds called *amino acids.* These amino acids are the "building blocks" from which proteins are made. The chemical arrangement of the amino acids determine the quality of the protein.

During digestion, proteins are broken down into amino acids. These are absorbed from the intestine into the blood stream and carried to all parts of the body. Then they are recombined to form body tissue.



NO TWO PROTEINS ARE ALIKE EVEN IF MADE OF THE SAME AMINO ACIDS!



Proteins that are eaten eventually become muscle, internal organs, bone and blood. Skin, hair, wool, hooves, horns and many other parts of the body are also made of protein. If an excess of protein is fed, the nitrogen portion of the protein can be separated from the rest of the nutrient and be discarded in the urine. The remaining materials can then be converted into energy by the animal.

The Vitamins

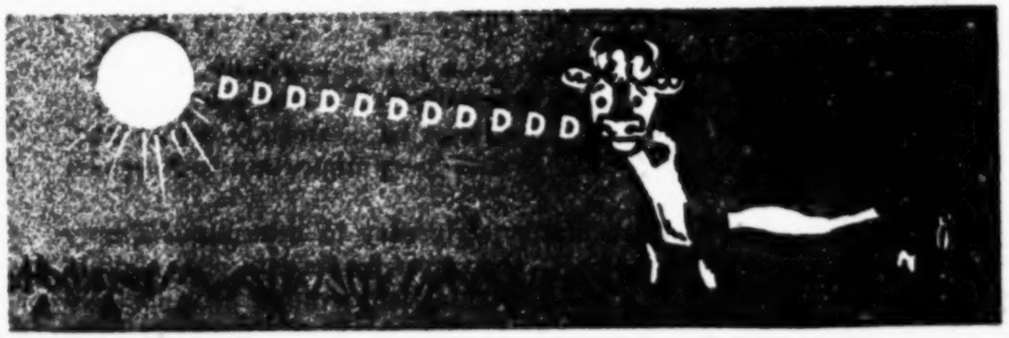
Although animals need large amounts of both energy and proteins, other nutrients are just as vital, but are needed in much smaller amounts. The *vitamins* are such a group.

For a long time, people noticed that certain diseases were caused by the lack of certain foods. Then modern science began analyzing the foods. They were found to contain small amounts of certain complex chemicals. Other foods did not contain them.

These nutrients were called vitamins, or "life amines." They are essential to normal body functioning.

The vitamins are not chemically alike. Each one also has a different job in the body. Still, they are all classed together under the term vitamins. This is because they are all organic compounds. (They contain carbon.) Also, all of them are needed only in very small amounts. For example, the vitamin A requirement for a steer is about 50 milligrams daily. This is about the amount represented by the heads of 5 common pins.

Vitamin A is responsible for the health of the eye and the tissue of nasal passages and lungs. Vitamin D is responsible for the strength and proper development of bones and the mineral balance in the blood. Other vitamins have just as important functions.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Some animals require only certain vitamins in their feed, whereas others can manufacture some of their own. Feeds are a good source of certain vitamins. Carotene in green grass is a good source of vitamin A. Sunshine and sun-cured hay are good sources of vitamin D.

The Minerals

Like vitamins, minerals are usually needed only in small amounts. Unlike vitamins, they are inorganic—they do not contain carbon. Iron, copper, phosphorus, calcium and magnesium are examples of minerals.

Minerals are important in the chemical reactions of the body. Without them, many life processes could not take place. Without iron in the blood, for instance, oxygen could not be carried to the body's cells. Anemia is a nutritional disease of baby pigs caused by a lack of iron and copper (specific minerals) in the sow's milk.

Without calcium and phosphorus proper bone and tooth formation would not take place. These are examples of the need for minerals.

Water as a Nutrient

The last item on our list of nutrients is so common that we seldom think of it as a nutrient. But *water* is the largest single part of nearly all living things. The body of a pig or calf is three-fourths water.

Water performs many tasks in the body. It makes up most of the blood, which carries nutrients to the cells and carries waste products away. Water is necessary in most of the body's chemical reactions. In addition, water is the body's built-in cooling system. It regulates body heat. It acts as a lubricant.

Life on earth would not be possible without water. An animal can live longer without food than without water.

Finding Out What's in Feeds

Research has provided the information that is available about the different kinds of nutrients. The scientist has developed methods by which the amount of each nutrient in a feed can be accurately determined. Knowing the nutrient content of a feed is very important to livestock raisers.

Water is one of the nutrients that is fairly easy to determine. Simply take a sample of a feed and weigh it. Then heat the feed sample slightly above the boiling point of water. Hold it at this temperature until the feed stops losing weight. Then weigh the feed. This weight is subtracted from the weight before heating. The difference between the two weights represents the amount of water driven off by the heat. To find the percentage of water, divide the dry weight by the original weight.

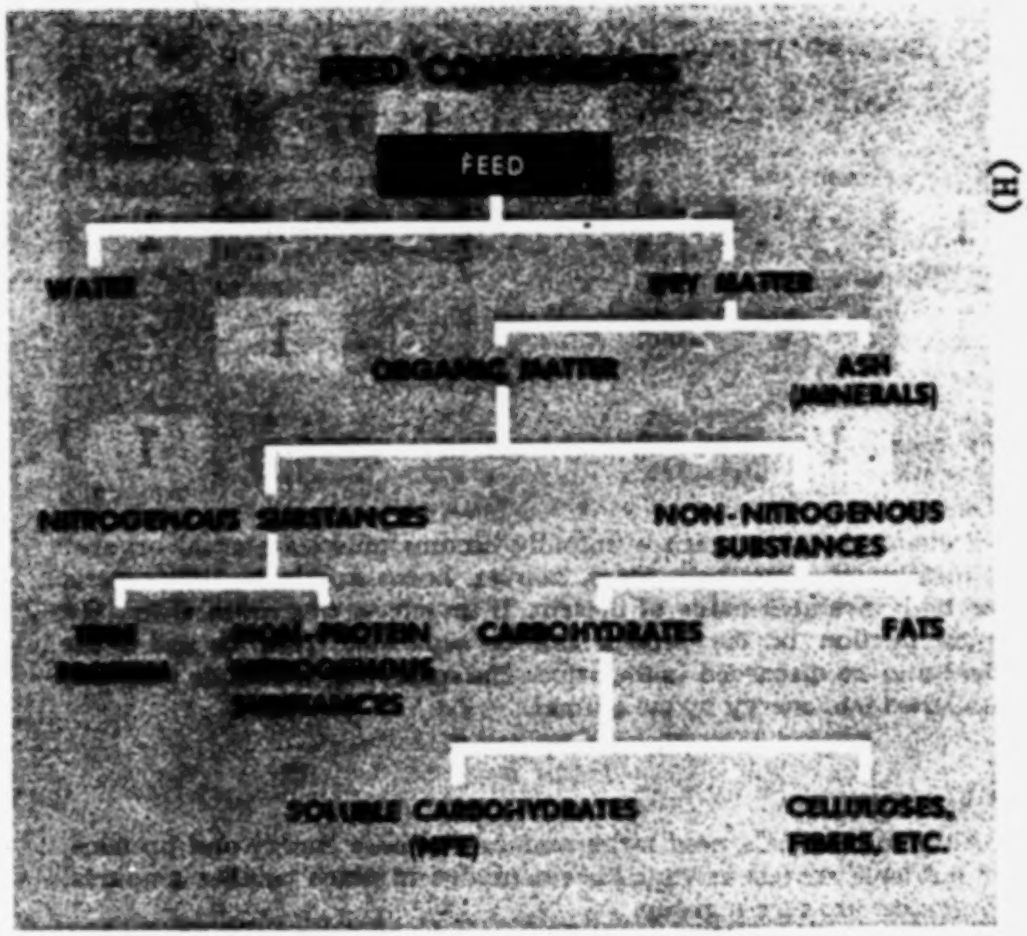
Another fairly simple analysis is to find out how much mineral is in the feed. Recall that minerals are inorganic chemicals. As such they will not burn. When feed is completely burned, a whitish-gray ash is left. If the weight of this ash is divided by the original weight of the feed before burning, the percent mineral, or ash, is obtained.

The chemical analysis gets more complicated when you are determining how much protein is in a feed. Recall that protein is made up of carbon, hydrogen and oxygen plus nitrogen. Scientists have learned that protein is about 16 percent nitrogen. Using certain chemical tests, the amount of nitrogen in a feed can be determined. Multiplying this amount by 6.25 (16 percent nitrogen divided into 100 = 6.25) gives the amount of *crude protein* in a feed. It is called crude protein because it includes all nitrogen compounds. There may be some nitrogen compounds in the feed which are not true proteins.

Another test is for the amount of fat in a feed. Since fat dissolves in ether, a sample of the feed is heated in ether for several hours. Then the feed is removed, and the ether is evaporated. The residue that is left is the fat, or *ether extract.*

It is important to know the fiber content of feeds. This is because fiber is hard to digest. Therefore, feeds with a high fiber content are less nutritious.

To find the fiber content, some of the feed is dissolved in a weak acid or alkali. Fiber (very complex carbohydrates) will not dissolve; it is left over. Any material that the weak acids or alkali will not dissolve is considered to be indigestible by animals. Keep in mind that the cells in the lining of the stomach secrete a weak solution of hydrochloric acid.



If the percentage of water, minerals, fat, fiber and protein are added together, the total will be something less than 100 percent. This difference is referred to as the nitrogen-free extract. This extract includes the more soluble carbohydrates, sugars, starch and some cellulose. All of these are readily digested in the digestive tract.

When the amounts of different nutrients in a feed are known, the quality or feeding value of the feed can be easily determined. By adding the digestible organic nutrients (protein, nitrogen-free extract and fat x 2.25), we can tell the "energy value" of a feed. TDN—total digestible nutrients—is the term used.

PRE QUIZ

FEED NUTRIENTS

1. Water is or is not a nutrient?
2. Antibiotics are or are not nutrients?
3. Stilbestrol is or is not a nutrient?
4. Supplements must always be fed to all animals. (True - False)
5. The same supplement will be o.k. to feed the pigs, cattle, and chickens. (True - False)
6. Give three possible reasons for having silage analyzed.
7. The more water a feed has in it the (greater or less) the feed value as measured by T.D.N.
8. An animal that is healthy but loses weight is probably lacking what class of nutrients?
9. A 5-week-old pig has plenty of corn and water in front of him. What nutrient(s) will likely be lacking?
10. What effect will this have on the pig?

Lesson 4. Digestion, Absorption, Metabolism 2 days

OBJECTIVES:

1. To compare carbohydrate, fat and protein digestion in swine and in cattle.
2. To understand absorption and metabolism as the end products of digestion.

REFERENCES:

AS 65 Slides 19 - 36

		Page
Handouts:	"Digestion, Absorption, Metabolism"	191
	"Pre Quiz"	195

MOTIVATION:

Give the Pre Quiz.

OUTLINE:

A. Digestion of Carbohydrates - for energy
  1. Ruminants - mostly grass
    a. Digestion takes place in rumen mostly.
    b. Bacteria and protozoa break into mild fatty acids which are ready to be absorbed.
    c. Some carbohydrates get through the rumen and are digested in true stomach.
  2. Nonruminants - mostly grains
    a. Digestion begins in mouth (saliva breaks starch into sugar).
    b. Sugars are further broken down in small intestine and absorbed.

B. Digestion of Fats - also for energy
  1. Ruminants and nonruminants digest fats similarly.
  2. Abomasum or stomach secretes an enzyme that breaks fats into fatty acids and glycerol.
  3. Process continues in small intestines with help of liver bile and an enzyme from the pancreas.

- C. Digestion of Protein - tissue builder
  - 1. Ruminants
    - a. Digestion begins in the rumen where bacteria break protein into ammonia gas.
    - b. Bacteria then rebuild ammonia into essential amino acids using them for their own bodies.
    - c. Bacteria die and the proteins they have manufactured are digested in the small intestine.
    - d. This reduces "quality of protein problem" in cattle feeding and permits feeding urea which is chemically a close relative of ammonia.
  - 2. Nonruminants
    - a. Digestion begins in the stomach. Pepsin breaks protein into small protein chains.
    - b. In the small intestine more enzymes break small chains into amino acids.
    - c. Specific amino acids are essential (10 different ones in hogs.) Proteins containing these must be fed.

- D. Absorption - passage into the blood stream.
  - 1. Short-chain fatty acids are readily absorbed from the rumen.
  - 2. Most absorption is from the small intestine where millions of villi greatly increase the surface area.
  - 3. Rate of absorption decreases as food leaves first part of small intestine.
  - 4. Liver bile is necessary to absorption of fat.

- E. Metabolism - using end products of digestion
  - 1. Products end up in muscle cells or liver.
  - 2. Most are broken down a little more and used where needed.
    - a. To replace worn out cells
    - b. To build new body tissue
    - c. For energy
    - d. Stored to be used later

PROCEDURES:

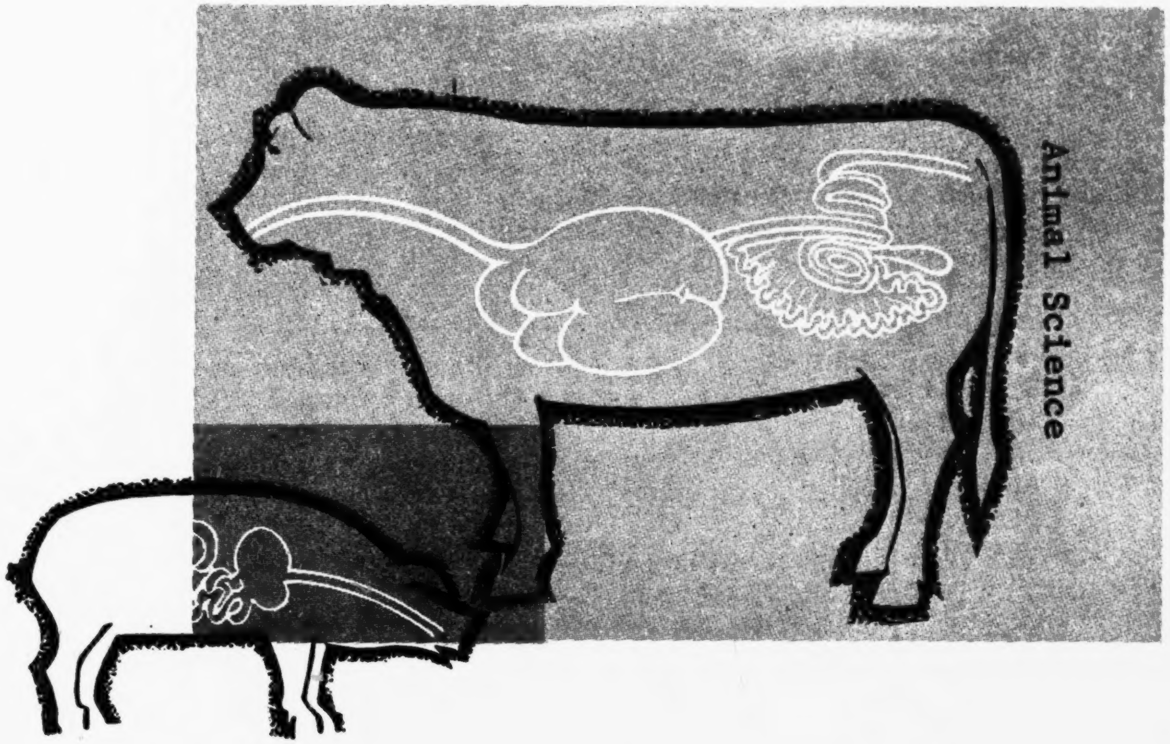
1. Give the Pre Quiz.

2. Show the slide set to illustrate items in the Outline.

3. Discuss the Pre Quiz.

SUMMARY:

DIGESTION, ABSORPTION, METABOLISM



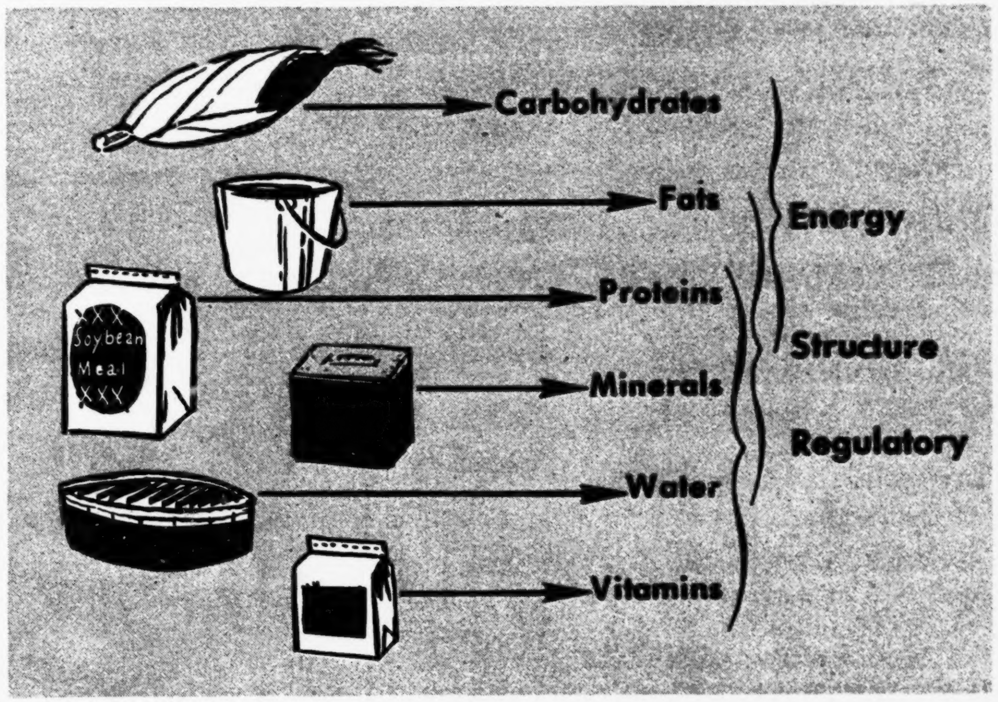
Any of three things can happen to the feed you give your animal. It can be used for energy or for fattening. It can be used to build body tissue. That which is left over passes through the body as waste.

Of course, feed is not used in the form it is fed. Beef isn't much like hay. Nor is pork much like corn. Feed must be taken apart before it can be used. Then it is put back together in another form.

You have learned that feeds are made up of various "chemicals." Digestion is a series of reactions during which feed is broken down into the units of which it is made. These are the end products of digestion.

The end products are absorbed through the lining of the digestive tract. They are carried to all parts of the body by the blood where they are built into body tissue, used for energy or stored as fat.

This process of using end products is called metabolism.



Source: Dr. T. W. Wickersham, Extension Animal Scientist, Iowa State University

Digestion of Carbohydrates

Remember that carbohydrates are energy nutrients. Ruminants usually get most of their carbohydrate from hard-to-digest feed such as grass. Pigs (nonruminant) get most of theirs from grain. The main carbohydrate in grass is cellulose. The main one in grain is starch.

In cattle, carbohydrate digestion starts in the rumen. There, with the aid of bacteria and protozoa, carbohydrates are broken down into particles called short-chain fatty acids. These are the end products.

What are short-chain fatty acids? They are very mild acids. One of the more common ones is acetic acid, which you are probably familiar with. Common vinegar is mostly acetic acid and water.

Some carbohydrates get through the rumen of cattle without being digested. Those which do are digested just as in nonruminant animals in the true stomach or abomasum.

In pigs (nonruminants), carbohydrate digestion begins in the mouth. While the animal chews, saliva is added to the feed. Saliva contains an enzyme called salivary amylase. This enzyme acts on starch by breaking it down into sugars. (A scientist would call these disaccharides, which are a combination of two simple sugars. Common table sugar is a disaccharide.)

Salivary amylase continues acting on starch for a time after it reaches the stomach. Then, stomach acid stops the reaction.

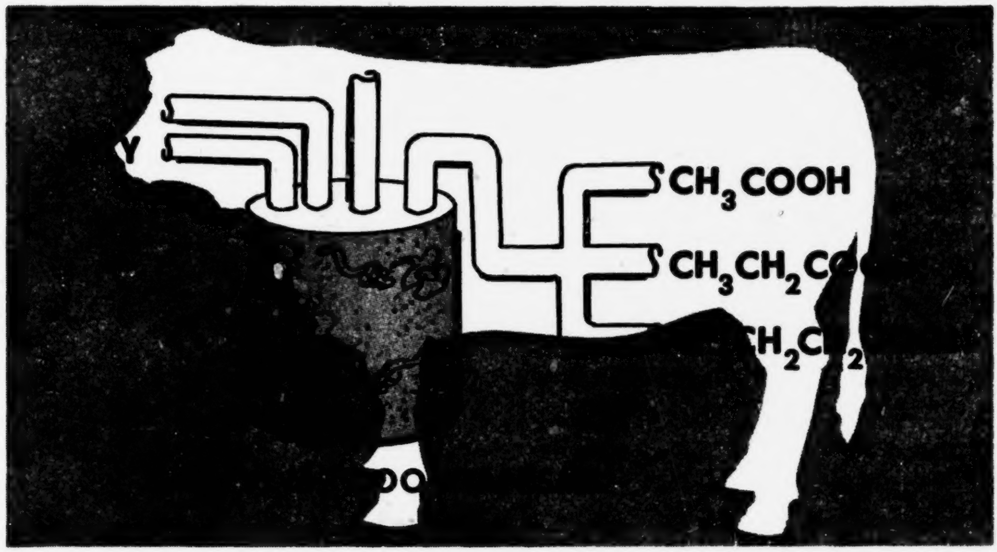
Nothing more happens to carbohydrate in pigs until it reaches the small intestine. By that time, most carbohydrate has been broken down into disaccharides. Those which have not been broken down react with another enzyme—pancreatic amylase.

Finally, several more enzymes are added to the contents of the small intestine. These enzymes continue the process of breaking the disaccharides into simple sugars. These are the end products of carbohydrate digestion.

Digestion of Fats

The other main type of digestion is the digestion of fats. These, like carbohydrates, are fuel nutrients. They are made up of fatty acids and glycerol. (These fatty acids are more complex than the short-chain fatty acids in ruminant digestion of carbohydrates.)

Digestion of fat is about the same in both cattle and pigs. In cattle, fat digestion takes place in the abomasum and small intestine. In pigs, it takes place in the stomach and small intestine.



In the stomach or abomasum, an enzyme called gastric lipase acts on fats. It breaks them down into fatty acids and glycerol. In the small intestine, the breaking down process is continued with a similar enzyme-pancreatic lipase.

The process is aided by bile from the liver. Liver bile softens up fats, physically breaking them apart. This makes them easier to break down into fatty acids and glycerol—the end products.

Digestion of Protein

Another nutrient which is digested differently in ruminants and nonruminants is protein.

Proteins are the nutrients from which body tissue is built. Humans and certain other animals eat meat because it is a source of high-quality protein. The high quality of the protein in meat is due to the excellent combination of essential amino acids which it contains. During digestion the proteins are broken down into the amino acids of which they are made. These amino acids are the end products of digestion in pigs.

Protein digestion in pigs begins in the stomach. There, an enzyme called pepsin initiates the action on protein. The result is the formation of small protein chains. The protein chains pass on to the small intestine, where more enzymes are added. These enzymes break down the protein chains into amino acids. The amino acids are absorbed through the small intestine wall.

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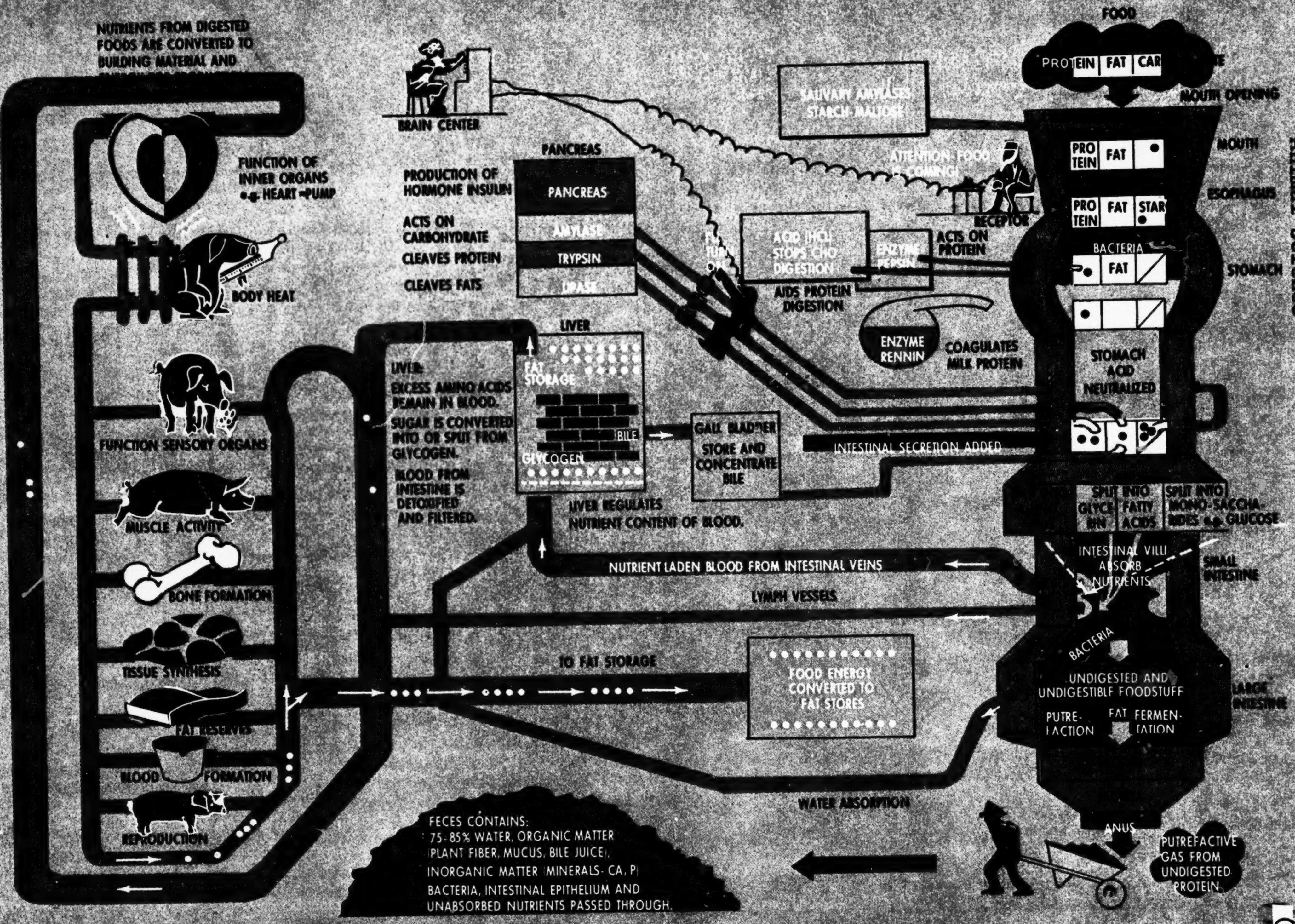
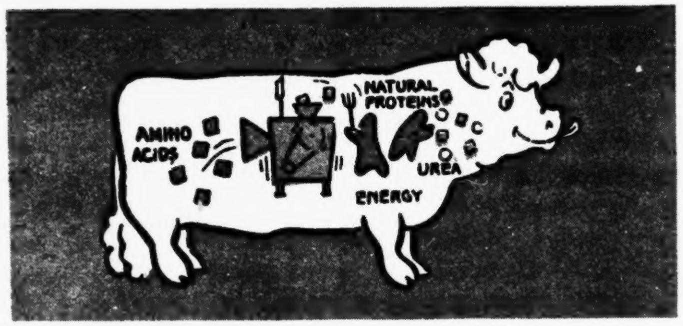

FOOD
PROTEIN FAT CAR
MOUTH OPENING
MOUTH
ESOPHAGUS
STOMACH
PRO TEIN
FAT
PRO TEIN
FAT
STAR
BACTERIA
FAT
STOMACH ACID NEUTRALIZED
SPLIT INTO GLYCERIN
SPLIT INTO FATTY ACIDS
SPLIT INTO MONO-SACCHARIDES e.g. GLUCOSE
INTESTINAL VILLI ABSORB NUTRIENTS
SMALL INTESTINE
BACTERIA
UNDIGESTED AND UNDIGESTIBLE FOODSTUFF
PUTREFACTION
FAT FERMENTATION
LARGE INTESTINE
ANUS
PUTREFACTIVE GAS FROM UNDIGESTED PROTEIN
SALIVARY AMYLASES STARCH-MALTOSE
ATTENTION: FOOD IS COMING!
RECEPTOR
BRAIN CENTER
ACID (HCL) STOPS CHO DIGESTION
ENZYME PEPSIN
ACTS ON PROTEIN
AIDS PROTEIN DIGESTION
ENZYME RENNIN
COAGULATES MILK PROTEIN
INTESTINAL SECRETION ADDED
PANCREAS
PANCREAS
AMYLASE
TRYPSIN
LIPASE
PRODUCTION OF HORMONE INSULIN
ACTS ON CARBOHYDRATE
CLEAVES PROTEIN
CLEAVES FATS
LIVER
FAT STORAGE
BILE
GLYCOGEN
GALL BLADDER STORE AND CONCENTRATE BILE
LIVER:
EXCESS AMINO ACIDS REMAIN IN BLOOD.
SUGAR IS CONVERTED INTO OR SPLIT FROM GLYCOGEN.
BLOOD FROM INTESTINE IS DETOXIFIED AND FILTERED.
LIVER REGULATES NUTRIENT CONTENT OF BLOOD.
NUTRIENT LADEN BLOOD FROM INTESTINAL VEINS
LYMPH VESSELS
TO FAT STORAGE
FOOD ENERGY CONVERTED TO FAT STORES
WATER ABSORPTION
FECES CONTAINS:
75-85% WATER, ORGANIC MATTER (PLANT FIBER, MUCUS, BILE JUICE),
INORGANIC MATTER (MINERALS- CA, P)
BACTERIA, INTESTINAL EPITHELIUM AND UNABSORBED NUTRIENTS PASSED THROUGH.
NUTRIENTS FROM DIGESTED FOODS ARE CONVERTED TO BUILDING MATERIAL AND
FUNCTION OF INNER ORGANS e.g. HEART=PUMP
BODY HEAT
FUNCTION SENSORY ORGANS
MUSCLE ACTIVITY
BONE FORMATION
TISSUE SYNTHESIS
FAT RESERVES
BLOOD FORMATION
REPRODUCTION

In cattle, protein digestion is more complicated. It begins in the rumen—again with the aid of bacteria. Bacteria are small animals and require a certain combination of amino acids to develop their own bodies. These bacteria break down the proteins in the rumen into ammonia gas. This is one of the simplest forms of nitrogen.


AMINO ACIDS
NATURAL PROTEINS
UREA
ENERGY

Nitrogen must ordinarily be combined in the proper proportion with many other elements before it can be used by an animal. But the bacteria in the rumen have a special ability to build new amino acids. They may be the same or different from the amino acids in the feed. The bacteria use these new amino acids in building their own bodies. As bacteria in the rumen die and pass on into the abomasum and small intestine, the protein in their bodies is digested and used by the ruminant. The amino acids are then absorbed into the blood stream from the intestine.

This cooperative arrangement between rumen bacteria and cattle make cattle easier to feed. For one thing, since the bacteria in the rumen can use simple forms of nitrogen, cattle can be fed nonprotein nitrogen such as urea. Also, since the bacteria can make one amino acid from another, or make new amino acids from simple nitrogen, there are no "essential" amino acids for cattle. Cattle require some source of nitrogen, but they do not have to be fed a specific balance of amino acids. These are called the essential amino acids.

Absorption and Metabolism

We have talked a lot about end products being absorbed after digestion. Absorption is a general term. It means the passage of a substance into the blood stream. It may occur from the surface of the body, from body cavities or any of the body organs. We are concerned with absorption from the digestive tract.

There is practically no absorption from the mouth or esophagus. The tissue in these organs is not suited for absorption. Also, food is not yet broken down enough to be absorbed. Nor is food present in them long enough to be absorbed.

In nonruminants, the stomach tissue is also not suited for absorption, except to a small extent. The same is true in ruminants, except for the rumen. Short-chain fatty acids are quickly absorbed from the rumen.

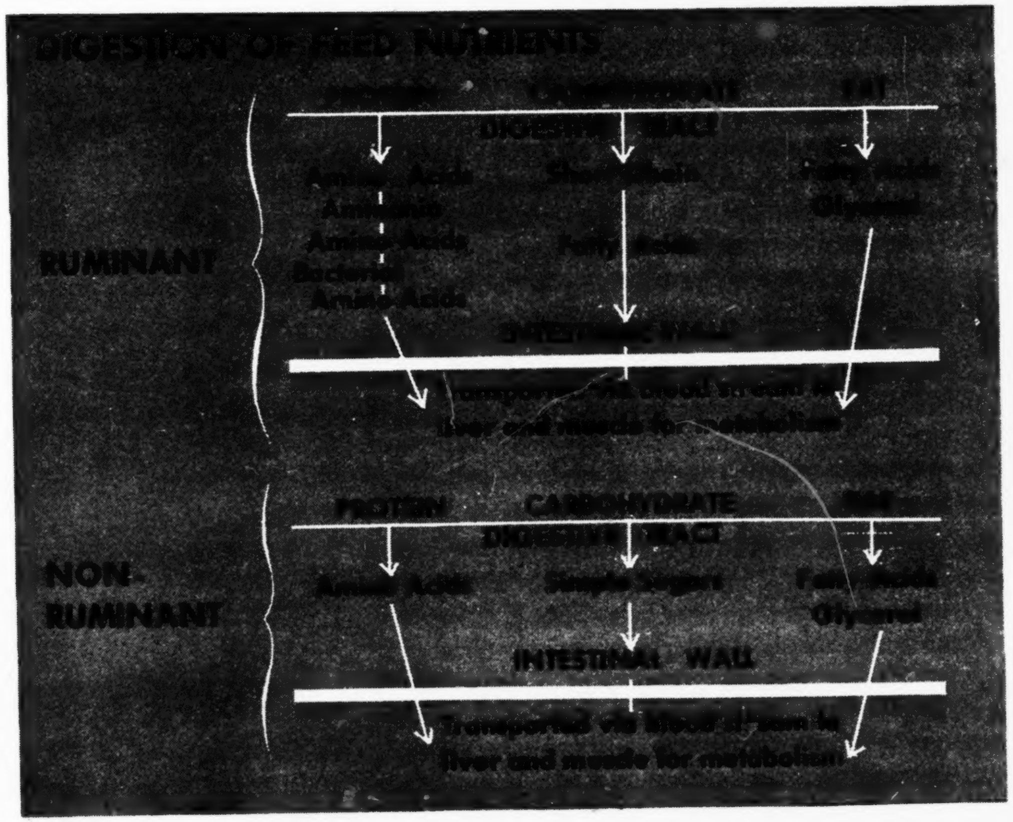
Most absorption is from the small intestine. Its surface is covered with millions of small, finger-like projections called villi. These have the effect of increasing the surface many times, hence its function in absorption.

Both proteins and carbohydrates are absorbed mostly in the first part of the small intestine. The rate of absorption decreases as the food moves along.

Most fat is also absorbed in the small intestine. This is done with the aid of liver bile, which is essential to fat absorption.

After absorption, the end products of digestion are carried through the blood stream. Most of them end up in the muscle cells or the liver. This is where most *metabolism* takes place.

During metabolism, most end products are broken down a little further to provide the specific type of fuel or material that is needed by the cells. Some are used to replace worn-out cells. Some are used to build new body tissue. Some are used for energy. Some are stored for later use.


DIGESTION OF FEED NUTRIENTS
RUMINANT
PROTEIN
CARBOHYDRATE
FAT
DIGESTIVE TRACT
Amino Acids
Ammonia
Amino Acids
Bacterial Amino Acids
Short-chain Fatty Acids
Fatty Acids
Glycerol
INTESTINAL WALL
Transported via blood stream to liver and muscle for metabolism
NON-RUMINANT
PROTEIN
CARBOHYDRATE
FAT
DIGESTIVE TRACT
Amino Acids
Simple Sugars
Fatty Acids
Glycerol
INTESTINAL WALL
Transported via blood stream to liver and muscle for metabolism

PRE QUIZ

DIGESTION, ABSORPTION, METABOLISM

1. Cattle and swine both produce saliva. Digestion in (hogs, cattle) starts in the mouth.

2. Bacterial digestion is important in carbohydrate digestion in swine. (True - False)

3. Enzyme digestion is important in carbohydrate digestion in cattle. (True - False)

4. Urea (can, cannot) be fed to hogs.

5. Digestion is similar in pigs and man. (True - False)

6. Cattle must be fed supplements containing the essential amino acids. (True - False)

7. A pig could carry on digestion and absorption of the major nutrients without a stomach. (True - False)

8. A steer has to have fat in the ration to fatten. (True - False)

9. Diseases of the small intestine cause feed to be excreted too rapidly, excreted too slowly, digested poorly, absorbed poorly. (Underline correct answer(s).)

10. The liver plays a bigger part in digestion than metabolism. (True - False)

Lesson 5. Principles for Determining Nutrient Requirements.

1 day

OBJECTIVES:

1. To further understand the scientific concept of nutrient requirement.

2. To understand four principles for determining nutrient requirements.

REFERENCES:

AS 65 Slides 37 - 46

		Page
Handouts:	"Learning About Nutrient Requirements"	199
	"Pre Quiz"	203

MOTIVATION:

We have seen that rather exacting requirements have been devised for feeding livestock. We are interested now in finding out more about what is behind these requirements. Have you ever wondered why hogs have much more exacting feed requirements than cattle?

OUTLINE:

A. Different kinds of animals have different nutrient requirements.

B. Nutrient requirements vary with stage of life cycle and level of performance desired.

C. Nutrients are required in amounts which will promote maximum growth or production and prevent nutritional deficiencies.

D. Nutrient requirements can be met with different feeds.

PROCEDURES:

1. Give the Pre Quiz. Save discussion until the close of the lesson.

2. Show the 5 slides that accompany this lesson from the AS 65 set and discuss these with the class.

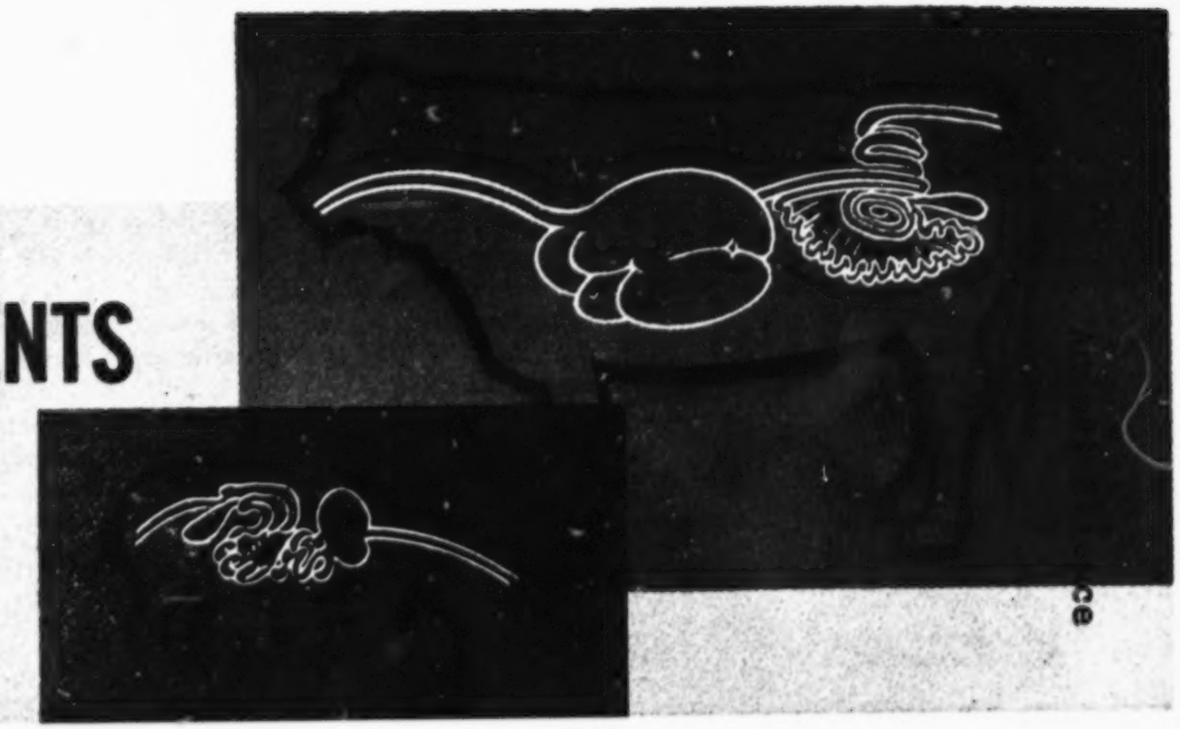
3. Refer to Tables 1, 2 and 3 in Lesson 1 handout to discuss nutrient requirement tables.

4. Briefly discuss the Nutrition Glossary.

5. Review the Pre Quiz.

SUMMARY:

LEARNING ABOUT NUTRIENT REQUIREMENTS



How did you find out what to feed your animals? Perhaps it was from your father, your course work or your teacher. You were probably told what to feed and exactly how much to feed. Or perhaps you followed instructions given by a feed company. Specific feeding instructions are usually printed on the back of feed tags.

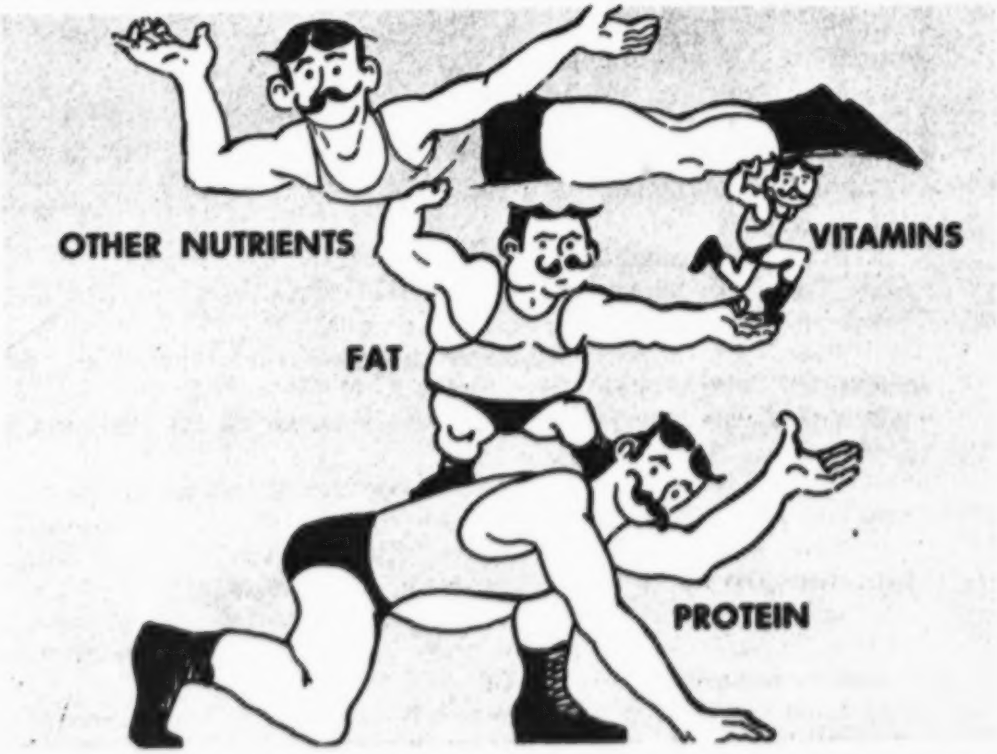
But how do these people know? How do you figure out the right balance of proteins, fats, vitamins and all the other nutrients?

The science of animal nutrition can help you. Scientists have learned what nutrients animals need. They have learned about animals' nutrient requirements.

At least they have learned a lot about nutrient requirements. Scientists are still learning. They constantly search for knowledge which will improve the performance of livestock.

Underlying the scientists' search for the right nutrients are certain principles. These principles guide scientists in their research. They guide livestock raisers in their feeding programs.

There are four principles we should know.

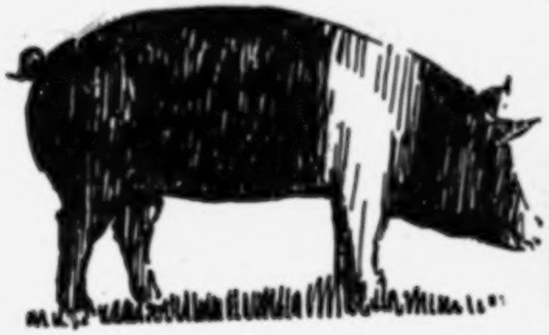


Source: Dr. T. W. Wickersham, Extension Animal Scientist, Iowa State University

1 Species differ in nutrient requirements.

This principle simply says that different kinds of animals need different nutrients.

The digestive tracts of hogs and cattle are different. Their nutrient requirements are also different. You know that the bacteria in the rumen of cattle can manufacture amino acids—the nitrogen building blocks of protein. For this reason, there are no essential amino acid requirements for cattle. Cattle must be fed nitrogen in some form, but they do not need specific amino acids.



AMINO ACIDS

Pigs, on the other hand, must receive all of their amino acids in their feed. There are 23 known amino acids. Pigs must have 10 of them. So there are 10 essential amino acids for pigs.

There are other examples of how different animals need different nutrients. Take vitamins, for instance. Hogs need at least six of the B vitamins. Cattle do not need any. Bacteria in the rumen can manufacture B vitamins.

That's how vitamin B12 was discovered. Before its discovery, scientists had guessed it existed. It was often called the "cow manure factor."

Why so? People had noticed that pigs root in cattle droppings. Scientists then learned that pigs got a needed nutrient from the manure. This nutrient was being manufactured in the digestive tract of cattle. Some of it was passing through the body into the manure. The nutrient was isolated and named vitamin B12.

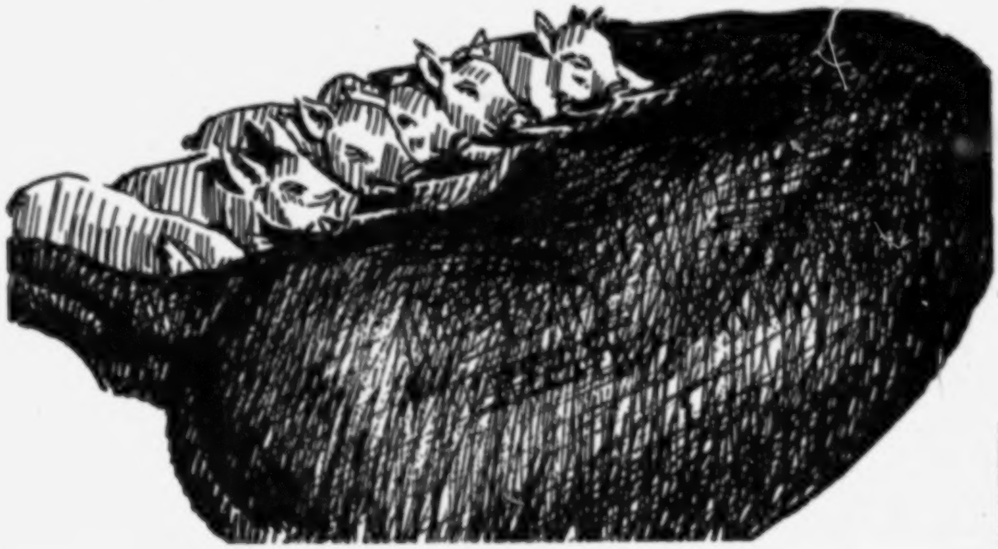
Later it was discovered that B12 is a by-product when antibiotics are manufactured. This makes a good, cheap source of the vitamin.

2 Nutrient requirements depend on the stage of the life cycle and on the performance desired.

The first food a newborn calf or pig receives is milk.

As the animal grows, its diet changes. This is because its nutrient requirements change. When an animal is young, it needs lots of nutrients which will help it grow. A grown animal, however, simply needs nutrients to maintain its body. We can see this in the protein content of pig rations. A pig pre-starter contains 18 to 20 percent protein; a starter contains 16 percent; the grower, 14; and the finisher, 10 to 12 percent. Scientists have found these to be the right amounts of protein according to the pig's life cycle.

In cattle, nutrient requirements change as the development of the rumen occurs. At birth the rumen makes up about 25 percent of the stomach. At 4 months, it makes up 75 percent. And at maturity, the rumen makes up 80 percent of the stomach. This is the reason why calves cannot digest roughage as mature cattle can.



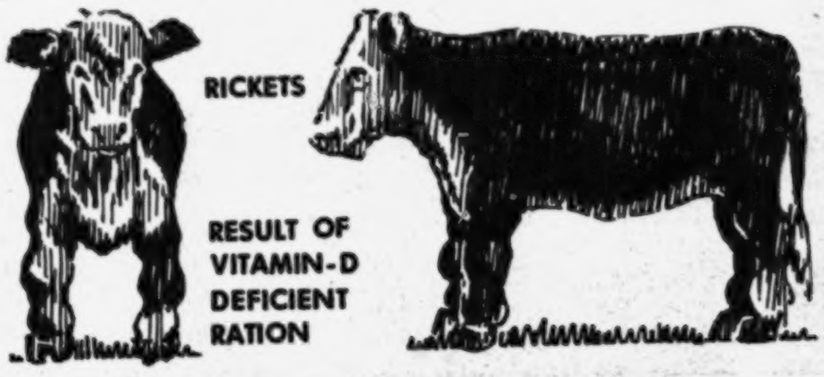
Then too, nutrient requirements are different for animals being kept for different purposes. For example, a beef heifer being fattened for market would receive a certain ration. This same heifer would have a different ration if she were being grown out for a herd replacement. The nutrient requirements differ according to the desired objective.

3 Nutrients are required in amounts which will promote maximum growth or production and prevent nutritional deficiencies.

We want the best possible production from our animals. We want a good rate of gain, feed efficiency, litter size or calf crop percentage. Nutrient requirements are calculated to insure maximum performance.

On the other hand, to overfeed is a waste. It may be harmful to the animals, too. Research with sows and beef cows, for instance, shows that the reproductive rate is lowered by overfeeding.

Nutritional deficiencies must be prevented in all livestock. Protein is the nutrient from which muscle is built. But it would be a foolish farmer who fed his hogs nothing but protein. Animals need a balance of nutrients for their bodies to function properly. Vitamins, minerals, proteins, fats, carbohydrates—they are all needed. And they are needed in the right amounts and in the right proportions.



RICKETS

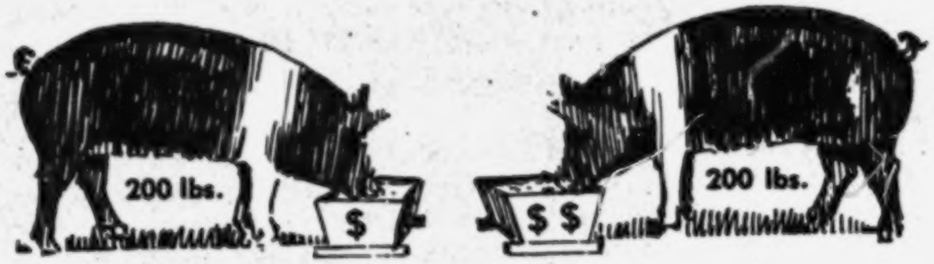
RESULT OF VITAMIN-D DEFICIENT RATION

If an animal does not get enough of a single needed nutrient, there is a general deficiency. The result will be poor performance, ill health, inferior reproduction or other symptoms. One common example is rickets in calves. Rickets occur when a calf is kept out of the sun with no vitamin D in its diet. Such deficiencies usually happen only by mistake.

So these are three principles of animal feeding. An animal's diet depends on the kind of animal, its age, and the purpose for which it is fed.

4 Nutrient requirements can be met with different feeds.

There are many different feeds that an animal will eat and that can be fed. A combination of feeds is often needed to meet the nutrient requirements. But you often have a choice of feeds with about the same nutritional value. It is usually logical to feed the one lowest in price.


200 lbs.
$
$ $
200 lbs.

The proportion of different ingredients in the ration can also be altered within limits. When the price of corn goes up, cattle feeders sometimes feed more roughage than corn. In feeding hogs, more or less supplement and corn could be fed, depending on the price of each.

The nutrient requirements of animals must be met. But the requirements are not so exact that prices of ingredients are ignored. The goal in feeding is to get the desired performance at the least cost.

Nutrient Requirement Tables (see lesson 6)

With these principles to guide them, scientists have figured out the nutrient requirements of certain animals. Their findings are published in what are called "nutrient requirement tables."

There is a different nutrient requirement table for each kind of animal. There are tables for beef cattle, dairy cattle, swine, sheep, dogs, laboratory animals and so on.

Nutrient requirement tables indicate the needs for each major nutrient of an animal in its daily feed. Requirements are given according to stage in the life cycle (age or weight of the animal) and the desired performance (growing, fattening, breeding, wintering, etc.)

The amounts of nutrients are given in two different systems. You may see a nutrient requirement table with the heading "Daily Nutrient Requirements of Beef Cattle." This table will tell how much of each nutrient the animal needs each day. The amount is given in some unit of measure such as pounds, grams or milligrams.

Or you may see a table with the heading "Nutrient Requirements of Beef Cattle Expressed as a Percentage of Air-Dry Ration." This kind of table indicates the total pounds of feed an animal should have each day and the percent of the daily ration to be made up by each nutrient.

The "daily nutrient requirements" table is usually used for cattle. For hogs, a table giving percentages is most often used. This is because hogs are often fed complete ground rations. When you know the percent of each nutrient, you know the formula for the ration.

Column Headings

In both types of tables, the individual column headings are about the same.

(1) *Body weight*—Nutrient requirements vary with the weight or age of the animal. To find the nutrient requirements for a calf, you must first know its approximate weight. Then find this weight on the table and read across for the nutrient requirements. Swine tables usually give requirements related to both weight and age.

(2) *Average daily gain*—This figure tells about what gain in weight you can expect from your animal when it is fed the amounts of nutrients shown on the chart. The figure is an average, so your animal's daily gain may be either higher or lower. For some types of cattle, zero or little gain is indicated. For many mature breeding cattle, the nutrient requirements only maintain weight, not add to it.

(3) *Daily feed*—This figure indicates, in pounds, about how much of the common feeds an animal should eat daily in order to meet its nutrient requirements. In some cases this is enough to satisfy the appetite. In other cases, the figure is much lower than the appetitie of the animal. This is because the real nutrient requirements are sometimes met with less feed than the animal would eat by itself.

(4) *Nutrients*—Finally, the tables indicate the amounts of nutrients needed by animals.

For cattle, the nutrients given include: total protein; digestible protein; total digestible nutrients (TDN); calcium (Ca); phosphorus (P); carotene; and vitamin A.

The tables for swine include: percent protein, calcium and phosphorus; units of vitamins A and D; micrograms of vitamins B12; and milligrams of riboflavin, pantothenic acid, niacin and choline.

Since nutrient requirements vary with the life cycle and the purpose, the tables list nutrients in purpose categories.

Categories for beef cattle are: fattening calves finished as short yearlings; fattening yearling cattle; fattening 2-year cattle; wintering weanling calves; wintering yearling cattle; wintering pregnant heifers; wintering mature pregnant cows; cows nursing calves; normal growth heifers and steers; normal maintenance, growth and activity of bulls.

In swine the categories are: young boars, adult boars; bred gilts and sows; lactating gilts and sows; growing pigs; and finishing pigs.

A NUTRITION GLOSSARY

CRUDE PROTEIN (total protein) is a measure of all the nitrogen-containing compounds in a feed. Some nitrogen compounds are not true proteins, so this is only a rough measure.

DIGESTIBLE PROTEIN tells approximately the amount of true protein in a feed. In roughage rations it is figured at 60 percent of the crude protein. In high-concentrate rations it is 75 percent of the crude protein.

ETHER EXTRACT is a term applied to the material that can be dissolved out of a sample of feed heated in ether. Fat has 2.25 times the energy value of carbohydrates. When the energy value of a feed is being calculated, the ether extract is multiplied by 2.25.

FIBER content of a feed is the amount of hard-to-digest carbohydrates. Most fiber is made up of cellulose.

NITROGEN-FREE EXTRACT (NFE) of a feed indicates the more easily digested carbohydrate. The NFE is mostly starch and sugars.

ESSENTIAL AMINO ACIDS are those amino acids which cannot be made in the body from other substances or which cannot be made in sufficient quantity to supply the animal's needs.

PRE QUIZ

PRINCIPLES FOR DETERMINING NUTRIENT REQUIREMENTS

1. The need for protein (stays the same, decreases, increases) as pigs increase in weight.

2. Vitamin B_{12} is included in all beef supplements. (True - False)

3. A table entitled "nutrient allowances" provides a higher level of nutrients than a table titled "requirements." (True - False)

4. Brood sows would farrow large litters of healthy pigs if fed corn and water. (True - False)

5. Your beef calf would fatten satisfactorily on hay-lage. (True - False)

6. A livestock feeder can change a feeding program to lower costs if what condition is met?

7. If certain nutrients are fed in excess they can be (stored, excreted, used, harmful, helpful). Which is correct?

8. The nutrient requirement tables are not likely to change now for 25 years. (True - False)

9. Morrison's Feeds and Feeding gives tables on feeding standards. (True - False)

Lesson 6. Using Nutrient Requirement Tables 1 - 2 days

OBJECTIVES:

1. To become familiar with names of feed ingredients.
2. To see how rations for livestock can be prepared scientifically.
3. To create an interest in learning more about how animals convert feedstuffs into more valuable products.

REFERENCE:

		Page
Handouts:	"Using Nutrient Requirement Tables"	207
	"Balancing Beef Cattle Rations Worksheet"	211
	"Swine Ration Worksheet"	212
	"Pre Quiz"	213

MOTIVATION:

What are you feeding your hogs (beef) at home? How much? Is this the best ration? Could it be too expensive? Too inefficient? How can we find out whether animals are being fed for efficient results?

OUTLINE: How to Evaluate a Ration

A. Select an animal - kind, weight and purpose.

B. Record the appropriate nutrient requirements on the worksheet.

C. List the feedstuffs being fed.

D. Record the amount of each.

E. Multiply % composition x amount and record result.

F. Add the columns.

G. Check against the requirements.

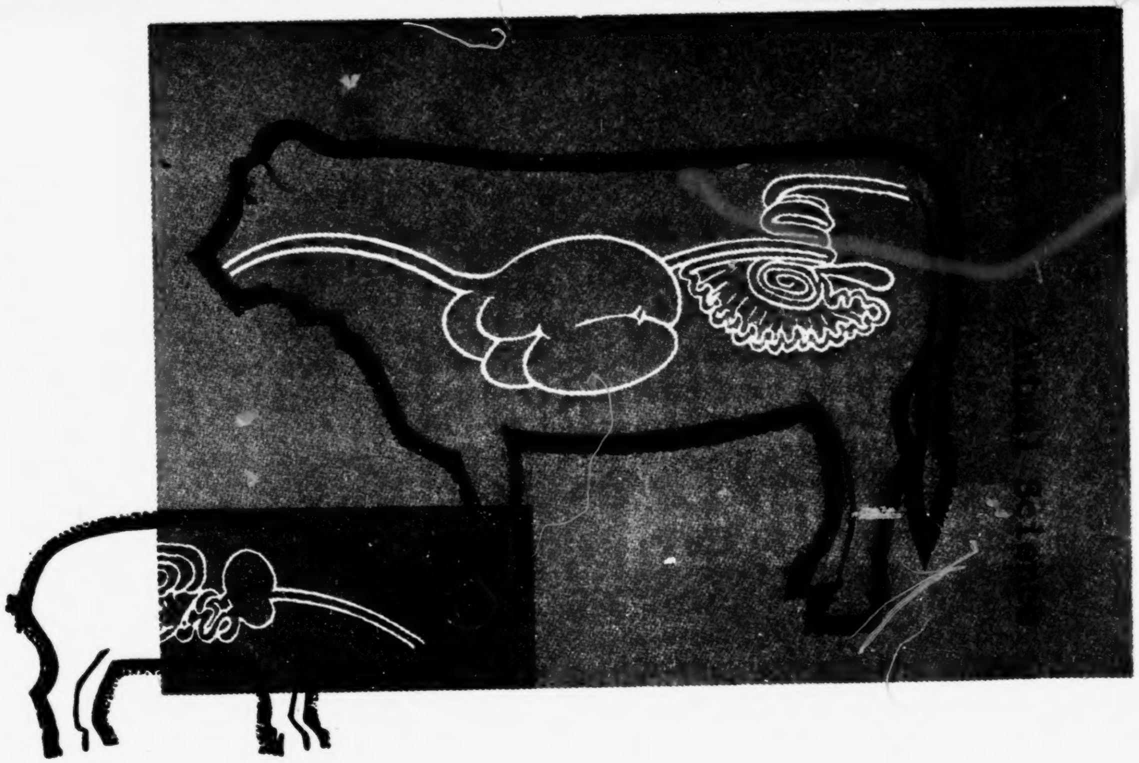
H. Try changing to balance the ration if necessary.

PROCEDURES:

1. Give the Pre Quiz.
2. Show the slide set.
3. Use a blank worksheet transparency and work out an example ration with the class.
4. Have students work another example.
5. Discuss the Pre Quiz.

SUMMARY:

USING NUTRIENT REQUIREMENT TABLES



We can use Nutrient Requirement Tables in at least two ways: (1) to check the ration presently being fed to see if it is nutritionally adequate, or (2) as a basis for formulating rations that will meet the nutrient requirements of the animals.

The materials needed are: (1) the nutrient requirement tables, (2) a table giving the composition or nutrient content of common feedstuffs, and (3) a worksheet for systematically recording the results of your calculations. You will need scratch paper for doing the multiplying, adding and dividing necessary. A nutritionist almost always has access to a calculator which speedily and accurately does the arithemetic you will do longhand.

You will note that some nutrients are required in very small amounts. This impresses us with the fact that we are out of the "scoop shovel" era in nutrition into a much more scientific period. Livestock feeding is moving rapidly from an art to a science.

In this lesson you can become a junior nutritionist (a scientist, if you please).

Before You Start

It will be necessary for you to multiply, add, subtract and divide *accurately*. You will be working with percentages, so be sure you are careful about decimal placing.

Some of the nutrient requirements are given in grams (gm.). Feed is given in pounds. To change pounds to grams, multiply by 454. This is the number of grams in a pound. You may find some requirements given in milligrams (mg.). For these nutrients the composition of the feed is also given in milligrams so you need not make any conversion.

Calculations are made of feedstuffs on an air-dry basis. This means that there is some moisture in them (10 to 15 percent). We do not correct for this much moisture. However, it is necessary to convert feeds such as

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Source: Dr. T. W. Wickersham, Extension Animal Scientist, Iowa State University

green chopped forage, haylage or silage to an air-dry basis. You need to know the moisture (or dry matter) content to correct to an air-dry basis. For example, 35 pounds of corn silage containing 70 percent moisture is equivalent to about 11 2/3 pounds of air-dry material. This correction is made by multiplying the weight of the material as fed by the percent dry matter and then dividing the product by 90 (85-90 being the dry matter content of most feeds that are "air-dry").

Follow This Procedure

1. Choose the kind of animal, weight and purpose.

2. Record pounds, grams, milligrams or I.U. (international units) and the amounts of the required nutrients. (Use table No. 1-B for beef and 1-S for swine.)

3. List the home-grown, common or natural feedstuffs being fed. Copy the average composition or analysis for all the nutrients opposite each. (Use table 2 and the swine or beef worksheet.)

4. Weigh the amount of each feedstuff being fed the animal daily. If a complete ration is being fed, then you must know the amount of each feed ingredient in a pound (or ton) of feed.

5. Multiply the percentage composition for each nutrient times the quantity of the feed being fed. Record the result in the appropriate column. Repeat for each nutrient.

6. Add the columns. This gives the total amount of each nutrient contained in the ration being fed.

7. Check this amount against the requirement as taken from table 1. If the *requirement* is more than that contained in the ration, we would conclude that the ration was deficient—that is, lacking adequate levels of that nutrient for optimum growth or performance. The next step would be to find a feed ingredient that was a good source of the deficient nutrient and add enough that the deficiency was erased. In doing this we would have to recalculate the ration to be sure we hadn't gotten other nutrients out of balance.

The values arrived at by the calculations need to be viewed with some caution. If the feed fed was of lower quality than average, the performance of the animal would be somewhat lower. Therefore, it is common practice for nutritionists to provide more of certain critical nutrients than is actually indicated by the calculations. This is done as insurance against any deficiency or poor performance showing up.

Table 1-B (Beef)

*Daily Nutrient Requirements of Beef Cattle
(Based upon air-dry feed containing 90 percent dry matter)

Body weight lb.	Av. daily gain[1] lb.	Daily feed per animal lb.	Total protein lb.	Digestible protein lb.	TDN lb.	Ca gm.	P gm.	Carotene[2] mg.	Vitamin A IU
			DAILY NUTRIENTS PER ANIMAL						
FATTENING CALVES FINISHED AS SHORT YEARLINGS									
400	2.3	11.8	1.3	1.0	7.8	20	15	22	8,850
600	2.4	16.4	1.8	1.3	10.9	20	17	31	12,300
800	2.2	19.4	1.9	1.5	12.9	20	18	37	14,600
1000	2.2	28.0	2.3	1.7	15.3	21	21	44	17,300
FATTENING YEARLING CATTLE									
600	2.6	17.5	1.8	1.3	11.4	20	17	33	13,100
800	2.7	22.3	2.2	1.7	14.5	20	20	42	16,700
1000	2.6	25.8	2.6	1.9	16.8	23	23	49	19,400
1100	2.3	25.8	2.6	1.9	16.8	23	23	49	19,400
WINTERING WEANLING CALVES									
400	1.0	10.5	1.1	0.7	5.3	13	10	20	7,900
500	1.0	12.6	1.3	0.8	6.3	13	10	24	9,500
600	1.0	14.3	1.3	0.8	7.2	13	10	27	10,700
WINTERING YEARLING CATTLE									
600	1.0	14.3	1.2	0.7	7.2	13	11	27	10,700
800	0.7	15.8	1.2	0.7	7.9	13	12	30	11,900
900	0.5	15.8	1.2	0.7	7.9	13	12	30	11,900
WINTERING PREGNANT HEIFERS									
700	1.5	20	1.5	0.9	10.0	15	14	50	20,000
900	0.8	18	1.4	0.8	9.0	13	12	45	18,000
1000	0.5	18	1.4	0.8	9.0	13	12	45	18,000
WINTERING MATURE PREGNANT COWS									
800	1.5	22	1.7	1.0	11.0	16	15	55	22,000
1000	0.4	18	1.4	0.8	9.0	13	12	45	18,000
1200	0.0	18	1.4	0.8	9.0	13	12	45	18,000
NORMAL GROWTH HEIFERS AND STEERS									
400	1.6	12.2	1.4	0.9	6.4	16	11	23	9,200
600	1.4	16.4	1.5	0.9	8.2	16	12	31	12,300
800	1.2	19.1	1.5	0.9	9.6	16	13	36	14,300
1000	1.0	21.1	1.6	1.0	10.6	14	14	40	15,800

[1] Average daily gain for finishing cattle is based upon cattle receiving stilbestrol. Finishing cattle not receiving stilbestrol gain from 10 to 20% slower than the indicated values.

[2] Cattle can use carotene to satisfy their vitamin A requirement. The carotene requirement was calculated from the vitamin A assuming 400 IU of vitamin A per mg. of carotene.

* Nutrient Requirements of Beef Cattle, National Academy of Sciences - National Research Council - Publication 1137.

Table 1-S Recommended Nutrient Allowances for Swine.[1]

State of life cycle	Weight of pig, lbs.	PERCENT OF RATION			Vit. A*	Vit. D_2	AMOUNT PER POUND OF RATION				
		Protein %	Calcium %	Phosphorus %	units/lb.	units/lb.	Vit. B_{12} mcg./lb.	Riboflavin mg./lb.	Pantothenic acid mg./lb.	Niacin mg./lb.	Choline mg./lb.
BOAR & GILT											
Developer	200 to –	14	0.70	0.60	2000	300	10	2.0	6	15	400
SOWS											
Pregestation & gestation	– –	14	0.70	0.55	2500	300	10	2.5	8	15	400
Lactation	– –	16	0.90	0.70	5000	400	10	2.5	10	20	400
YOUNG PIGS											
Prestarter	– to 12	24	0.70	0.60	2500	450	20	5.0	10	30	500
Starter	12 to 25	18-20	0.70	0.60	2000	400	20	5.0	10	30	450
Grower	25 to 50	16	0.65	0.55	2000	350	10	2.5	6	20	400
OLDER PIGS											
Developer	50 to 125	14	0.60	0.50	1000	250	5	2.0	5	15	300
Finisher	125 to 200	12	0.60	0.50	1000	250	5	2.0	5	15	300

[1] The nutrient allowances are suggested for maximum performance not as minimum requirements. They are based on research work with natural feedstuffs and found to give satisfactory results.

* About 3 times as many units of pro-vitamin A (carotene) are needed as compared with true A.

Source: Swine Nutrition Research, Animal Science Department, Iowa State University, Ames, Iowa.

Table 2. Average Nutrient Content of Feedstuffs[1]

	Total dry matter %	Protein %	Dig. protein	Total dig. nutrients %	Calcium %	Phosphorus	Carotene mg/lb.	Vit. A IU/lb.	Vit. D IU/lb.	Riboflavin mg/lb.	Pantothenic A. mg/lb.	Niacin mg/lb.	Choline mg/lb.	Vit. B12 mcg/lb.
DRY ROUGHAGES														
Alfalfa hay, leafy	90.5	16.0	11.7	51.2	1.31	0.24	20.3	33,000	905	7.7	9.0	18.0	–	–
Alfalfa hay, stemmy	90.5	12.3	8.2	46.3	1.07	0.19	3.3	5,000	–	–	–	–	–	–
Alfalfa-brome hay	89.2	11.8	7.6	47.9	0.77	0.20	6.7	11,000	–	2.9	10.2	11.7	–	–
Corn cobs	90.4	2.3	–	45.7	0.11	0.04	–	–	–	–	–	–	–	–
SILAGES														
Corn, dent, well matured & eared	28.5	2.3	1.3	19.8	0.09	0.07	5.8	9,000	54	–	–	5.7	–	–
Alfalfa, wilted	36.2	6.3	4.3	21.5	0.51	0.12	11.4	19,000	131	–	–	–	–	–
Alfalfa-brome, not wilt	25.0	3.8	2.6	17.0	0.37	0.05	–	34,500	–	–	–	5.7	–	–
CONCENTRATES														
Corn, dent, No. 2	85.0	8.7	6.7	80.1	0.02	0.28	1.3	2,167	–	0.5	2.4	9.8	200	–
Ground ear corn	86.1	7.4	5.4	73.2	0.04	0.22	1.0	1,733	–	0.4	2.0	7.2	160	–
Oats	90.2	12.0	9.4	70.1	0.09	0.33	0.05	83	–	0.5	6.0	6.3	435	–
Barley	89.4	12.7	10.0	77.7	0.06	0.40	0.2	333	–	0.6	3.0	27.2	450	–
Cottonseed meal (45%)	94.3	45.6	37.4	75.1	0.23	1.12	0.1	167	–	2.7	5.5	16.3	1,301	–
Linseed meal (36%)	92.4	36.6	31.5	75.6	0.40	0.86	–	–	–	1.3	–	13.7	557	–
Soybean meal (50%)	91.7	50.4	46.4	79.4	–	–	0.1	167	–	1.4	–	9.8	1255	–
Feeding limestone	–	–	–	–	38.3	–	–	–	–	–	–	–	–	–
Steamed bonemeal	–	–	–	–	30.0	13.9	–	–	–	–	–	–	–	–

– indicates nutrient not present in feed or content not known.

[1] Morrison, F. B. Feeds and Feeding. Twenty-second edition. Morrison Publishing Co., Ithaca, N.Y.

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(H)

Animal Science

BALANCING BEEF CATTLE RATIONS WORKSHEET

Animal________________ Weight ________________ Daily Gain ____________

Section 1 Composition of Home-Grown Feeds

FEED	Dry matter %	Total protein %	T. D. N. %	Calcium %	Phosphorus %	Vit. A equivalent IU/ Lb

Section 2 Quantity of Nutrients in the Feeds

FEED	Lbs. fed (air-dry basis)	Protein (total) lbs.	T. D. N. lbs.	Calcium lbs.	Phosphorus lbs.	Vit. A equivalent I. U.
TOTAL						

Section 3 Daily Nutrient Requirements and Expected Gains

(Based on air-dry feed containing 90 percent dry matter)

Daily feed	Exp. gains	Total feed	Protein (total) lbs	T. D. N. lbs	Calcium lbs.	Phosphorus lbs.	Vit. A equivalent I. U.

Section 4 Balancing the Ration and Meeting the Requirements

Total from Section 2						
Ration deficiency						
Supplement						
Balanced ration						

SWINE RATION WORKSHEET

Ration for ______________
(Example: Young pig grower)

Ingredient	Pounds	Calculated Nutrient Content									
		Protein Pounds	Calcium Pounds	Phosphorus Pounds	Vit. A Units	Vit. D Units	Vit. B 12 mcg.	Riboflavin mg	Pantothenic acid mg.	Niacin mg.	Choline mg.
TOTALS											
Calculated analysis (percent or per lb.)		%	%	%	units	units	mcg.	mg.	mg.	mg.	mg
Nutritive requirements											

PRE QUIZ

USING NUTRIENT REQUIREMENT TABLES

1. Where would you go to get information on nutrient requirements?
2. Why bother about figuring nutrient content of rations?
3. What would you need to know about the ration in order to calculate its nutrient content?
4. What is a good reference on nutrient content of feeds?
5. Why is the nutrient requirement for swine most often given in percentage of the ration or units, milligrams or micrograms per pound of complete ration?
6. Would you change the ration being fed if the calculated nutrient content was greatly in excess in some one nutrient? If it were deficient in a nutrient?
7. Can you convert pounds to grams and grams to milligrams?
8. If a major nutrient requirement such as protein is being met by feeding a particular ration, can you assume that the rest of the nutrient requirements are being met, too?
9. In the requirement tables, carbohydrates and fats do not appear. Why? Aren't there requirements for these?
10. Do you know what group of nutrients are required by swine and appear in the swine table but not in the beef table? Why?

Subunit: Producing Swine for Profit 15 days

OBJECTIVES:

1. To understand the production cycle of a livestock enterprise.
2. To realize the importance of sound economic decisions for a profitable operation.
3. To practice making many of the important decisions encountered by farmers who raise hogs.
4. To become familiar with many of the approved practices generally adopted by successful hog farmers.
5. To become familiar with some of the career opportunities associated with livestock farming.

MOTIVATION:

What's a good way to tell whether a hog farmer is successful?

LESSONS:

	Days	Page
1. Selecting and Purchasing Breeding and Feeding Hogs	2	219
2. Managing Swine During Breeding and Gestation	3	229
3. Managing and Caring for the Sow and Litter	3	239
4. Growing, Finishing and Marketing Hogs	3	247
5. Controlling Diseases and Parasites	2	259
6. Providing Housing and Equipment for the Sow and Litter	2	269
	15	

GETTING READY FOR THIS SUBUNIT:

A. References and Materials
   1. Textbooks
      Livestock and Poultry Production
      Animal Science

2. Bulletins and Other Publications
   "Profitable Pork Production in Missouri"
   Catalog of Plans for Livestock Equipment
   Catalog of Swine Building and Equipment Plans
   MU Guides:
   - 2406 "Atrophic Rhinitis and Virus Pig Pneumonia"
   - 2408 "Swine Dysentery and Baby Pig Scours"
   - 2504 "Swine Sanitation"
3. Movies:
   Source: Communications Department
   119 Whitten Hall
   Columbia, Missouri 65201

		Minutes
"Pig Projects Make Profits"	Color	15
"Modern Pork Production"	Color	13½

B. Advance Arrangements

1. Select a student who plans a sow and litter project. Make sure it is reasonable for him to raise hogs. Become thoroughly familiar with his situation so you can help him explain it to the class when necessary.

   Throughout these six lessons focus upon solving the real problems of "Johnny." Get the boy to agree to accept the class decision and make sure the class realizes the importance of their responsibility. We need a "Johnny" because problems can only be solved in a real-world context.

   Alternatives to using an individual would be to use several students each with his own unique situations, a chapter hog project or a hypothetical situation. Some teachers and some classes may be better suited to one scheme than another.

   Hogs were chosen because of their popularity throughout Missouri. Another enterprise could be used, but it would require additional teacher preparation.
2. Have a student determine the local pricing situation for feeder pigs to be used in Lesson 1.
3. Have students bring feed tags for pre-starter, starter, growing and finishing supplements for comparisons in Lesson 4.

EVALUATION:

1. Give short objectives tests following each lesson.

2. Look for evidence of growth of pupils in ability to use

the background acquired in earlier subunits to solve problems in these lessons.

3. Observe students' attempts to solve similar problems with their farming programs.

Note: Many of the illustrations used in this subunit were prepared as a graduate project by Bob Stewart.

Lesson 1. Selecting and Purchasing Breeding and Feeding Hogs

2 days

OBJECTIVES:

1. To increase understanding of what a good meat type hog looks like.
2. To understand important considerations in selecting profitable swine.
3. To be able to make intelligent decisions about purchasing hogs.

REFERENCES:

Livestock and Poultry Production, pages 51 - 56; 72 - 82

Profitable Pork Production in Missouri, pages 4 - 8

Animal Science, pages 815 - 825; 842 - 850

		Page
Transparencies:	"Summary of Carcass Data For Two Pigs"	222
	"Heritability Estimates"	223
	"Requirements of a Certified Meat Type Litter"	224
	"Economics of Keeping Sows Longer"	225
	"Crossbred vs. Purebred Sows"	226
	"A Rotational Breeding Program"	227
	"A Pricing Method For Feeder Pigs"	228

MOTIVATION:

Why do you want a good hog? Sometimes the cheapest sow has the most pigs.

OUTLINE:

A. Meat type hogs should be produced
  1. Reasons
    a. Market premium
    b. Good rate of gain
    c. Good feed efficiency
    d. Benefit to swine industry from happy consumers

2. Selecting meat type
    a. Note that many meat traits have high heritability.
    b. Probe for back fat at 200 pounds
    c. Obtain carcass data on close relatives - certified meat type litter
    d. Visually inspect live animals.

B. Other factors should be considered.
    1. Rate of gain
    2. Feed efficiency
    3. Litter size
    4. Health
    5. Disposition
    6. Price

C. Crossbreeding pays off in increased litter size.
    1. 2 breed
    2. 3 breed
    3. 4 breed

D. Genetically, the boar is half of the herd.

E. Many producers would do better to buy feeder pigs.
    1. Management considerations
        a. Labor - management ability and availability
        b. Feed and capital available
        c. Disease problems
        d. Availability of feeder pigs
        e. Relative costs of buying and producing feeder pigs
    2. Purchasing considerations
        a. Reputation of the producer
        b. Type and conformation
        c. Health
        d. Price

PROCEDURES:

1. Discuss the reasons for producing meat type hogs. Show "Summary of Carcass Data for Two Pigs."

2. Discuss importance of selecting meat type breeding stock if one is interested in long range herd improvement. Show "Heritability Estimates." Does high heritability of a trait encourage us to pay special attention to it when selecting breeding stock? Show "Requirements of a Certified Meat Type Litter."

3. Discuss "Other Factors." Show "Economics of Keeping Sows Longer."

4. Show "Crossbred vs. Purebred Sows." Also show "A Rotational Breeding Program."

5. How much is a good boar worth to someone who is up-grading a sow herd?

6. Discuss why some should not try to raise pigs.

7. Discuss what to look for in purchasing feeder pigs. Show "A Pricing Method for Feeder Pigs." Use these to estimate prices of feeder pigs of different sizes. How does this compare with the local market today?

8. Decide upon a gilt(s) for "Johnny" and upon the boar he should use.

SUMMARY:

SUMMARY OF CARCASS DATA FOR TWO PIGS

	MEAT HOG	FAT HOG
SHOULDER	(Square inches)	
Fat Area	19.5	28.1
Muscle Area	91.5	80.6
Ratio Fat to Lean	1 to 4.7	1to 2.9
HAM		
Fat Area	24.2	33.2
Muscle Area	92.7	80.5
Ratio Fat to Lean	1 to 3.8	1to 2.4
LOIN		
Lean Area	3.53	2.15

Courtesy Rath Packing Company

HERITABILITY ESTIMATES

	Average
Items of conformation:	
Length of body	61
Length of legs	64
Number of vertebrae	74
Nipple number	60
Scores for conformation	26
Performance characters:	
Number of pigs farrowed	15
Number of pigs weaned	19
Weight of litter at weaning	17
Weight of pig at five months	.21
Growth rate from weaning to 200 lbs.	30
Economy of gains weaning to 200 lbs.	38
Items of carcasses:	
Length	61
Loin eye area	48
Backfat thickness	46
Belly thickness	61
Percent of ham	58
Percent of fat cuts	60
Percent of shoulder	47
Percent of lean cuts	34

University of Missouri Bulletin 775

REQUIREMENTS FOR A CERTIFIED MEAT TYPE LITTER

1. Production registry litter of 8 or more pigs.
2. Two pigs must be slaughtered.
3. They must weigh 200 pounds by 180 days of age.
4. Both must meet or exceed these carcass standards:
    - a. Cannot weigh over 220 pounds when slaughtered.
    - b. Length 29 inches or more (front of first rib to front of aitchbone.)
    - c. Backfat 1.6 inches or less.
    - d. Loin eye 4 square inches or more (backside of 10th rib.)

ECONOMICS OF KEEPING SOWS LONGER

No. of litters	Receipts less costs	Average receipts less costs
1	$ 61.85	$ 61.85
2	135.90	67.95
3	225.98	75.33
4	310.31	77.58
5	394.88	78.98
6	475.40	79.23
7	555.26	79.32
8	631.32	78.91
9	704.37	78.26

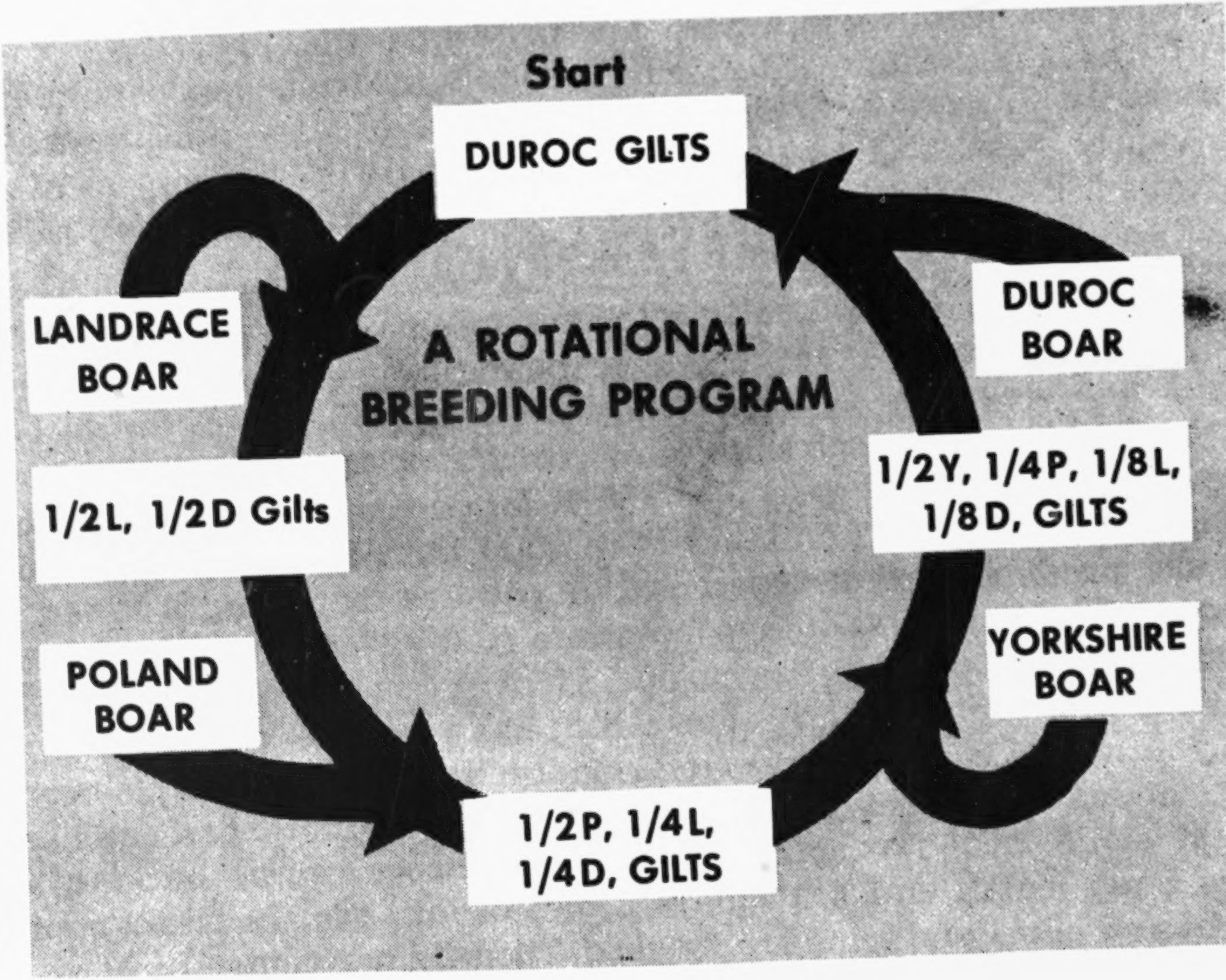
Agricultural Economics Department, Purdue

CROSSBRED VS. PUREBRED SOWS

	2-Breed Cross as % of Purebreds	3-Breed Cross as % of 2-Breed Cross	3-Breed Cross as % of Purebreds
Litter size at birth	99	108	107
Litter size at 56 days	119	123	142
Weight per pig at 56 days	107	100	107
Weight per litter at 56 days	128	123	151
Post-weaning rate of gain	107	100	107
Post-weaning efficiency of gains	999	101	100

University of Missouri Bulletin 775

Animal Science


A ROTATIONAL
BREEDING PROGRAM
Start
DUROC GILTS
LANDRACE BOAR
1/2L, 1/2D Gilts
POLAND BOAR
1/2P, 1/4L, 1/4D, GILTS
YORKSHIRE BOAR
1/2Y, 1/4P, 1/8L, 1/8D, GILTS
DUROC BOAR

Source: Iowa State University

A PRICING METHOD FOR FEEDER PIGS

50 pound pig	1.7 times top market price
60 pound pig	1.6 times top market price
70 pound pig	1.5 times top market price
80 pound pig	1.45 times top market price
90 pound pig	1.4 times top market price
100 pound pig	1.35 times top market price

University of Illinois figures

Lesson 2. Managing Swine During Breeding and Gestation 3 days

OBJECTIVES:

1. To understand various farrowing systems and some of their advantages and disadvantages.

2. To learn practices in the care of sows and boars which will usually result in a large, healthy pig crop.

REFERENCES:

Livestock and Poultry Production, pages 84 - 97

Profitable Pork Production in Missouri, pages 9 -15

Animal Science, pages 826 - 833; 840 - 842

		Page
Handouts:	"Comparison of One and Two Litter Systems"	232
	"Effect of Feeding on Performance of Gilts"	233
	"Effect of Feeding on Performance of Sows"	234
Transparencies:	"Birth weight and Per Cent of Pigs Weaned"	235
	"Birth Weight Compared To Weaning Weight"	236
	"Comparison of One and Two Services"	237

MOTIVATION:

Mature sows produce an average of 13.5 egg cells when they come in heat. Only nine of these develop into pigs. And, these aren't all the same. See "Birth Weight and Per Cent of Pigs Weaned" and "Birth Weight Compared to Weaning Weight." Why would care during gestation affect the weaning weight of a litter?

OUTLINE:

A. It usually pays for sows to farrow two times per year.

B. Many commercial hog producers have two or more sets of sows farrowing two times per year.
   1. More efficient use of boars, buildings, equipment and labor.
   2. Greater management skill required.
   3. Spreads marketings throughout the year.

C. June and July have had the highest average prices in recent years. There is considerable year-to-year variation, however.

D. Less building and equipment investment is required for pigs farrowed in warm weather and they can make greater use of pasture.

E. From our knowledge of the reproductive system and of the estrus cycle we can understand why we should:
   1. Flush sows 10 - 14 days before breeding.
   2. Breed on the first and second day of heat about 12 hours apart.

F. Recommended number of sows per boar varies with his age, condition and the breeding system used.

G. Good breeding condition for boars and sows (or gilts) is thrifty, perhaps gaining, but not fat.

H. To get sows to farrow together, wean pigs at same time.

I. To get gilts to farrow together, save extra gilts and sell those not bred by a specified time.

J. Sows should gain 60 - 80 pounds and gilts 75 - 100 pounds during gestation - greater part of gain during last 1/3 of the period.

K. Recommended rations during gestation vary with dry lot vs. pasture feeding, self feeding vs. hand feeding, feeds available, and age and condition of the sow or gilt.

L. Exercise is essential to sows and boars during the breeding season and to sows during gestation.

M. Recording the date each sow is bred will be helpful in planning for farrowing.

PROCEDURES:

1. Distribute "Comparison of One and Two Litter Systems."
2. Have students work out schedules for two farrowings and five farrowings per year. Include breeding, farrowing, weaning and marketing dates. Consider advantages and disadvantages of multiple farrowings.
3. Discuss Table 3, page 10 in Profitable Pork Production in Missouri.
4. Consider labor, equipment and facility requirements for farrowing different seasons of the year.
5. Study and discuss frequency and duration of estrus, the influence of condition upon ovulation and the influence of timing and number of services on fertilization. Show "Comparison of One and Two Services."
6. Have class develop a list of practices at breeding time which should increase the size of the pig crop.
7. Distribute "Effect of Feeding on Performance of Gilts." Also "Effect of Feeding on Performance of Sows."
8. Develop rules of thumb for feeding during gestation of sows or gilts; on dry lot or pasture; self fed or hand fed. What changes will need to be made as gestation progresses?
9. Discuss ways to provide exercise and plenty of water to pregnant sows.
10. What record should be kept during this stage in the production cycle?
11. Agree upon a "master plan" for "Johnny" to follow with his sow(s) during breeding and gestation.

SUMMARY:

COMPARISON OF ONE AND TWO LITTER SYSTEMS

	One-litter Systems				Two-litter Systems	
	Early Spring Farrow	Late Spring Farrow	Summer Farrow	Fall Farrow	Spring and Fall Farrow	Fall and Spring Farrow
No. pigs marketed per sow	4.6	5.9	5.8	5.7	10.5	11.8
Lbs. pork produced per sow	1212	1524	1484	1438	2626	2864
Lbs. feed per cwt. pork produced	407	397	428	437	433	435
Cost per cwt. total pork produced	$ 15.46	$ 14.25	$ 14.93	$ 14.91	$ 14.87	$ 14.54
Income per cwt. total pork produced	$ 18.53	$ 17.47	$ 17.53	$ 17.95	$ 18.21	$ 19.21
Net return per cwt. total pork produced	$ 3.07	$ 3.22	$ 2.60	$ 3.04	$ 3.34	$ 4.67
Cost per sow	$187.39	$217.14	$221.51	$214.45	$390.50	$416.37
Income per sow	$224.63	$266.23	$260.03	$258.15	$478.12	$550.15
Net return per sow	$ 37.24	$ 49.09	$ 38.52	$ 43.70	$ 87.62	$133.78

South Dakota Experiment Station Bulletin 435

EFFECT OF FEEDING ON PERFORMANCE OF GILTS

Treatments	Nor	Ltd	Nor	Ltd	Nor	Ltd	Nor	Ltd
Number in Lot	8	8	8	8	7	7	7	6
Avg. No. Pigs Farrowed	8	9.87	8	8.1	6.86	7.57	9.4	9.8
Avg. Birth Weight (lbs)	2.6	2.6	2.95	2.72	3.04	2.75	2.47	2.59
Avg. No. Pigs Weaned	4.4	6.8	6.87	5.87	3.57	5.3	4.8	5.0
Avg. Weaning Weight (lbs)	23.3	21.8	39.9	38.7	29.4	27.9	28.2	30.2
Percentage Weaned	55.0	69.6	85.9	72.3	52.0	70.0	51.5	50.8

Nor = Normal, Ltd = Limited, which represent the different planes of feeding.

University of Missouri Research Bulletin 774

EFFECT OF FEEDING ON PERFORMANCE OF SOWS

Treatments	Nor	Ltd	Nor	Ltd	Nor	Ltd	Nor	Inter	Ltd
Number in Lot	7	8	3	3	10	9	8	8	8
Avg. No. Pigs Farrowed	10.1	9.5	9.3	12.7	9.1	9.5	11.5	7.75	10.63
Avg. Birth Weight (lbs)	2.93	2.84	2.9	2.48	2.86	3.09	3.18	3.07	2.61
Avg. No. Pigs Weaned	5.71	7.62	4.3	9.3	5.3	5.6	8.1	6.0	7.5
Avg. Weaning Weight (lbs)	34.2	34.0	26.4	26.1	45.5	39.0	42.13	41.29	39.46
Percentage Weaned	56.4	60.3	47.0	71.7	58.2	58.9	70.7	77.4	70.6

Nor = Normal, Ltd = Limited, representing different planes of feeding.

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BIRTH WEIGHT AND PER CENT OF PIGS WEANED

Birth Weights (lbs)	Number Born	Percentage Weaned
0.8-1.0	10	0
1.1-1.3	26	4
1.4-1.6	54	20
1.7-1.9	89	40
2.0-2.2	119	49
2.3-2.5	139	61
2.6-2.8	242	75
2.9-3.1	202	73
3.2-3.4	226	78
3.5-3.7	155	83
3.8-4.0	82	85
4.1-4.3	30	90
4.4-4.6	8	87
4.7-4.9	6	100
5.0-5.2	1	100
5.3-5.5	1	100
	1431	

University of Missouri Research Bulletin 774

BIRTH WEIGHT COMPARED TO WEANING WEIGHT

Birth Weight Groups	Number of Pigs	Average Birth Weight	Weaning Weight 56 Days	Gain in Weight 56 Days	Daily Gain
Below 2.5 lb	81	2.2	25.7	23.6	.42
2.5-3.0	159	2.7	28.9	26.2	.45
3.0-3.5	206	3.2	32.9	29.7	.53
3.5 up	150	3.8	37.0	33.2	.59

University of Missouri Bulletin 461

COMPARISON OF ONE AND TWO SERVICES

	Number	Per Cent Settled	Pigs Farrowed
1 Service	149	61	7.9
2 Services	124	94	8.9

Lesson 3. Managing and Caring for the Sow and Litter 3 days

OBJECTIVES:

1. To learn to avoid principal causes of farrowing difficulties.
2. To choose between feeding programs intelligently.
3. To decide upon a set of good management practices to be followed in caring for sows and litters so as to wean large litters of vigorous, healthy pigs.

REFERENCES:

Livestock and Poultry Production, pages 98 - 119

Profitable Pork Production in Missouri, pages 16 - 22

Animal Science, pages 833 - 840; 877/ 881 - 882

		Page
Handouts:	"Age and Cause of Mortality of Pigs"	242
	"Baby Pig Feeding Program"	243
Transparencies:	"Weaning Weight Compared To Later Gains"	244
	"Conditions Recommended For Early Weaning of Swine"	245
	"Life Cycle Swine Nutrition"	246

MOTIVATION:

For every ten pigs born on Missouri farms it is estimated that only six or seven live to reach market weight. Most losses occur before weaning. This is probably the greatest drain on profits which the swine industry is forced to bear. Are there ways we can reduce these losses? What are some of the causes of pig losses you know about?

Pigs that do well during the suckling period do well later. See "Weaning Weight Compared to Later Gains."

OUTLINE:

A. Getting ready for farrowing
   1. Follow McClean County System of Sanitation.
   2. Pen the sow early.
   3. Provide adequate pen space - 6' x 8' or 8' x 8'.

4. Provide protection from sow mashing pigs (top floor of house, use guard rails - 8" above floor and 8" from wall, use farrowing stalls).
5. Provide heat in cold weather.
6. Add bulk to sow's ration .
7. Use ground corn cobs, chopped straw or shavings for bedding. Don't use much.

B. Recommended practices at farrowing time
    1. Be there when she farrows if possible.
    2. See that pigs get colostrum.
    3. Provide fresh drinking water to sow immediately.
    4. Feed sow 1 - 2 pounds of bran or ground oats first day, Increase gradually to full feed (10 - 14 pounds) by seven to ten days.
    5. Use heat lamps (safely) when temperature is below 65°F.

C. Care during gestation
    1. Clip needle teeth.
    2. Ear notch pigs.
    3. Protect against anemia.
    4. Creep feed.
    5. Provide clean pasture.
    6. Castrate before 4 weeks.
    7. Vaccinate for cholera at 6 to 8 weeks.
    8. Vaccinate for erysipelas at 8 weeks.
    9. Wean at 5 to 8 weeks.

D. Rations
    1. For sows on dry lot
    2. For sows on pasture
    3. For pigs
        a. Pre-starter
        b. Starter
        c. Grower

PROCEDURES:

1. Discuss the steps in getting ready for farrowing. Have the class decide exactly what "Johnny" should do before his sow(s) farrow.

2. Hand out "Age and Cause of Mortality in Pigs. What can we do about these?

3. Discuss the care of sows and pigs until weaning, pointing out the importance of recommended practices. When appropriate, be sure students learn how to do the practices.

4. Discuss early weaning (before eight weeks). What advantages in early weaning? Disadvantages? Show "Conditions Recommended for Early Weaning of Swine."

5. Recommend some rations for sows on dry lot and on pasture.

6. Show "Life Cycle Swine Nutrition." Emphasize the importance of spending whatever is necessary to get a pig started off right - that cheaper rations should be used later.

7. Show "Baby Pig Feeding Program." Get local prices and see how much feed will cost per pig to 56 days. Hand out "Baby Pig Feeding Program."

8. Decide upon management practices and rations for "Johnny's" hogs from farrowing to weaning.

SUMMARY:

AGE AND CAUSE OF MORTALITY OF PIGS

	Total	Days							Weeks						
		1	2	3	4	5	6	7	1st	2nd	3rd	4th	5th	6th	7th
Born Dead	193	--	--	--	--	--	--	--	---	---	---	---	---	---	---
Weak	70	26	21	9	3	4	2	3	68	2	---	---	---	---	---
Overlaid	61	14	2	2	5	4	1	3	31	18	7	2	3	---	---
Navel Ill	40	--	--	--	--	1	1	1	3	10	7	9	4	4	3
Starved	8	1	2	2	3	--	--	--	8	---	---	---	---	---	---
Swine Virus Pneumonia	2	--	--	--	--	--	--	--	---	---	---	1	1	---	---
Scours	1	--	--	--	--	--	1	--	1	---	---	---	---	---	---
Hernia	1	--	--	--	--	--	--	--	---	---	---	1	---	---	---
Misc. Diseases	11	1	3	--	--	1	--	1	6	2	1	---	---	2	---
TOTAL	392	42	28	13	11	10	5	8	117	32	15	13	8	6	3

University of Missouri Research Bulletin 774

Animal Science

BABY PIG FEEDING PROGRAM

Age of pig (days)	Approximate Weight of Pig (lbs.)		Kind of feed		Amount of feed needed (lbs.)	Feed per pound of gain (lbs.)
	At beginning	At end	Protein	Name		
7 to 14	5	8 or 10	24%	Prestarter "75"	3½ to 5	1.0
14 to 35	8	25	18%	Starter	20	1.2
35 to 56	25	50	14%	Grower	55	2.0

WEANING WEIGHT COMPARED TO LATER GAINS

Weaning Weight Groups	Number of Pigs	Ave. Weaning Weight	Gain Per Day	Weight at 6 Months of Age
15-20 lbs.	14	16.9	1.4	189.0
20-25 lbs.	40	22.2	1.4	196.0
25-30 lbs.	90	27.2	1.4	202.8
30-35 lbs.	78	32.1	1.4	208.8
35-40 lbs.	58	36.7	1.5	218.5
40-45 lbs.	26	41.7	1.5	228.2
45-50 lbs.	22	46.8	1.5	233.9
50-55 lbs.	7	52.9	1.6	254.0

University of Missouri Bulletin 461

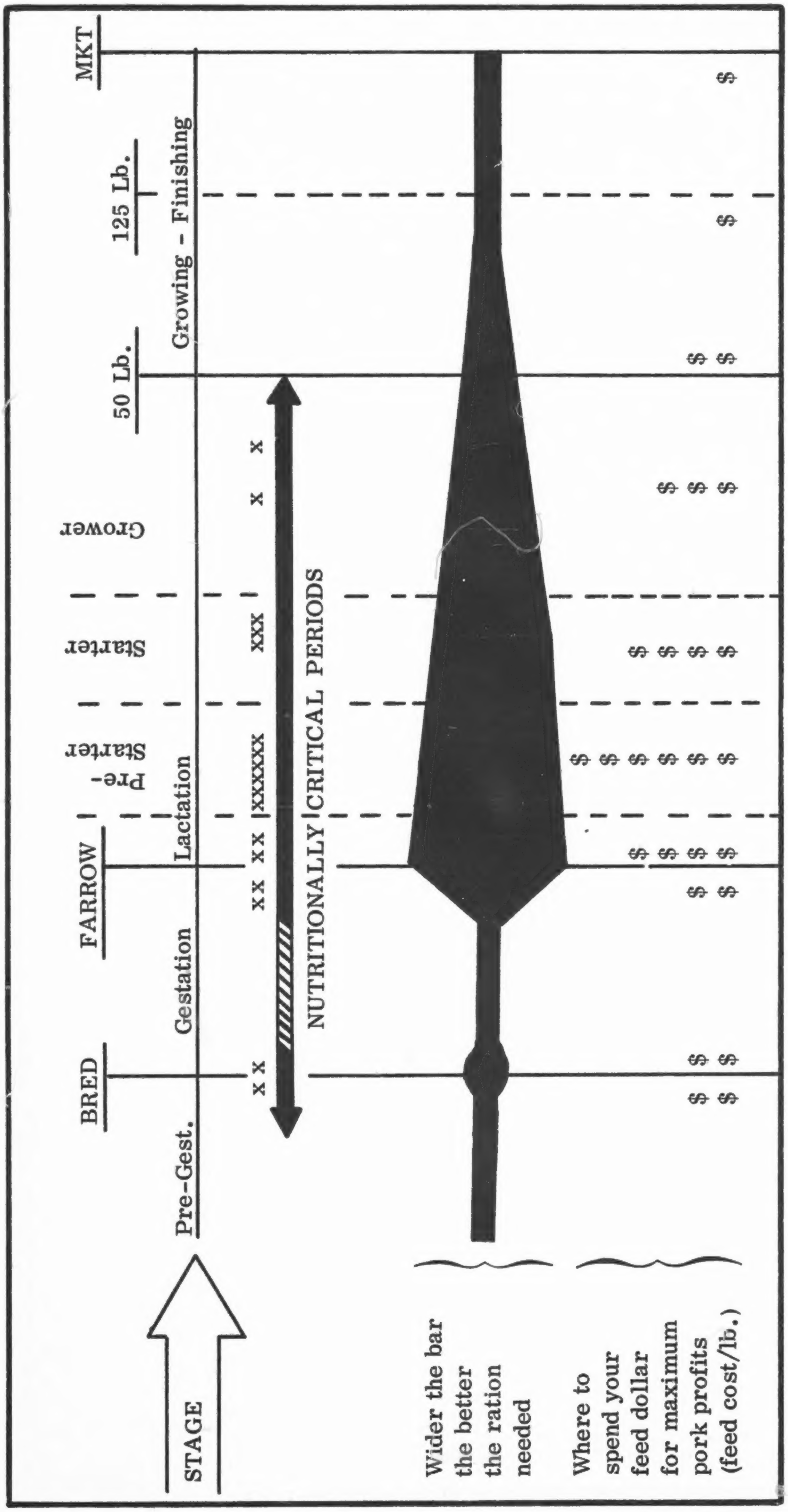
CONDITIONS RECOMMENDED FOR EARLY WEANING OF SWINE

Age in Weeks	5	4	3	2	1
Minimum Pig Wt. -- Lbs.	21	15	12	9	5
Farrowing House Temperature -- °F.	60	65	70	75	75
Minimum Floor Space per Pig -- Sq. Ft.	6	5	4	4	4
Maximum No. of Pigs per Feet of Feeder Space	4	4	4	5	5
Maximum No. of Pigs per Feet of Water Space	10	10	12	12	12
Maximum No. of Pigs per Group	25	20	10	10	10

For early weaned pigs, housing that is warm, dry, and draft free is required. Supplemental heat such as a heat lamp and special feeders and waterers are recommended.

American Feed Manufactures Association

LIFE CYCLE SWINE NUTRITION



Source: Iowa State University

Animal Science

Lesson 4: Growing, Finishing and Marketing Hogs 3 days

OBJECTIVES:

1. To understand how to use recommended practices with pigs being finished for market.
2. To be able to choose intelligently between: pasture and dry lot feeding, and complete rations and grain plus supplement, and the several markets available.

REFERENCES:

Livestock and Poultry Production, pages 120 - 145; 168 - 169; 172 - 179
Profitable Pork Production in Missouri, pages 23 - 32

Animal Science, 884 - 894; 895 - 902

		Page
Handout:	"Value of Corn Substitutes"	250
Transparencies:	"Pastures for Hogs--Advantages"	251
	"Advantages of Confinement Feeding"	252
	"Pasture vs. Dry Lot for Growing-Fattening Swine"	253
	"Rye Pasture vs. Concrete"	254
	"Pasture vs. Confined Feeding"	255
	"Swine Protein Requirements"	256
	"Shelled Corn and Supplement Free Choice vs Mixed Ration"	257

MOTIVATION:

After a pig is weaned, we still have about two-thirds of his cost ahead. This is where efficient producers should really look for ways to cut costs.

OUTLINE:

A. Pasture feeding
    1. Pasture vs. dry lot (advantages and disadvantages)
    2. Clean ground
    3. Pasture crops
    4. Litters per acre
    5. Mowing
    6. Ringing pigs
    7. Feeders and waterers

B. Rations
  1. The grains compared
  2. Supplements
    a. Protein
    b. Mineral
    c. Vitamin
    d. Antibiotic
    e. Arsenical
  3. Free Choice or Pre-mixed
  4. Grinding, pelleting, soaking
  5. Reading a feed tag

C. Special Practices
  1. Worming
  2. Keeping hogs cool in summer
  3. Feeding garbage
  4. Hogging down corn

D. Marketing
  1. Deciding when to sell
  2. Choosing a market
  3. Preventing marketing losses

PROCEDURES:

1. Compare the advantages of confinement and of pasture feeding.
   Show and discuss: "Pastures for Hogs - Advantages"
   "Advantages of Confinement Feeding"
   "Pasture vs. Dry Lot For Growing - Fattening Swine, Illinois Test"
   "Rye Pasture vs. Concrete , Kentucky Test"
   "Pasture vs. Confined Feeding, Oklahoma Test"
   Be sure students realize that comparisons should not be made between two tests since we cannot be sure there weren't differences in size and genetic makeup of animals, climate, etc. that would influence results.

2. Show how three pastures can be used conveniently to provide clean ground for hogs.

3. Have students work out a 3 year plan for rotating hogs using: corn - oats and Ladino Clover - Ladino Clover in a rotation.

4. List and discuss other management practices recommended for hogs on pasture.

5. Have students list some of the energy feeds. Hand out "Value of Corn Substitutes."

6. Look over some feed tags and consider what are the important ingredients.

7. Show "Swine Protein Requirements."

8. How do feed tags differ for pre-starter, starters, growing, finishing supplements?

9. Consider free choice of grain and supplement vs. pre-mixed complete ration. Show "Shelled Corn and Supplement Free Choice vs. Mixed Ration."

10. Briefly discuss the advantages of grinding and of pelleting.

11. Discuss the special practices listed in the Outline, C.

12. Have students check market reports to determine price differentials based on weights and grades of hogs.

SUMMARY:

VALUE OF CORN SUBSTITUTES

Feed	Bushels per ton	Relative fattening value %	Approximate value per bushel when a bushel of corn is worth:				
			$1.00	$1.25	$1.50	$1.75	$2.00
Shelled corn	35.7	100	$1.00	$1.25	$1.50	$1.75	$2.00
Grain sorghum (milo)	35.7	90 - 95	.95	1.19	1.42	1.66	1.90
Ground wheat	33.3	105	1.13	1.40	1.68	1.96	2.25
Ground barley	41.7	90 - 95	.70	.98	1.18	1.38	1.58
Ground rye	35.7	65 - 70	.70	.88	1.05	1.23	1.40
Ground oats	62.5	70 - 80	.43	.53	.64	.75	.86

PASTURE FOR HOGS

ADVANTAGES

1. Less feed required
2. Fewer disease problems
3. Nutrient deficiencies less likely
4. Reduces manure disposal problem
5. Cheaper feed handling system required
6. Pigs are "toughened up" physically
    a. Breeding stock
    b. Shipping long distances
    c. For gleaning corn field or fallowing steers
7. Fewer feet and leg troubles
8. Less initial investment in facilities
9. Less management ability required

ADVANTAGES OF CONFINEMENT FEEDING

1. Good farmland can grow a more profitable crop
2. Can handle more hogs in one operation
3. More suitable for automation
4. Less labor per head
5. Year-round production is possible which would reduce risk
6. Eliminates moving portable equipment
7. Easier to clean and disinfect
8. Easier to observe hogs regularly
9. Faster gains
   a. Hogs are more comfortable
   b. Feed, water, shade are close together
   c. Hogs usually sorted into smaller, more uniform groups

PASTURE VS. DRY LOT FOR GROWING FATTENING SWINE

ILLINOIS TEST

	Avg. Daily Gain	Feed/lb. Gain	Feed Cost cwt. Gain
Pasture	1.39	2.99	8.89
Dry Lot	1.41	3.04	9.06

Value of an acre of Pasture, 20 pigs, = $4.50 to $6.12

RYE PASTURE VS. CONCRETE

KENTUCKY TEST

	Avg. Daily Gain	Feed/lb. Gain	Carcass B.F.	Labor Man Hours
Concrete	1.48	3.81	1.49	34.6
Pasture	1.32	3.82	1.41	41.0

PASTURE VS. CONFINED FEEDING

LITTERS

Farrowing to weaning	Weaning to market	Avg. Daily gain	Feed/lb gain	B.F. Probe 200 lbs.
Confined	Confined	1.46	3.5	1.57
Confined	Pasture	1.33	3.5	1.52
Pasture	Confined	1.62	3.29	1.57
Pasture	Pasture	1.47	3.46	1.55

University of Missouri, Livestock Management Handout

SWINE PROTEIN REQUIREMENTS

Size of Hog	% Protein in Ration
Birth to 50 lbs.	18 - 20
50 - 100 lbs.	14 - 16
100 lbs. to Market	12
Sows	14 - 15

MU Guide 2353

SHELLED CORN AND SUPPLEMENT FREE CHOICE VS. MIXED RATION

Experiment Station	Feed/cwt gain Free Choice	Feed/cwt gain Mixed	Cost/cwt gain Free Choice	Cost/cwt gain Mixed
Missouri	388	390		
Nebraska	330	356	$10.08	10.57
Nebraska	315	361		
Nebraska*	332	349		
Illinois	303	306		
Purdue	317	327	8.72	9.76
Purdue*	304	310	8.09	8.76
Ohio	347	362	8.72	10.00
Missouri	376	377		
Illinois	278	279		
Iowa	371	361		

*Fed on pasture

University of Missouri, Animal Husbandry Department

Lesson 5: Controlling Diseases and Parasites

2 days

OBJECTIVES:

1. To learn to identify, prevent and control the most common diseases and parasites of swine.

REFERENCES:

Livestock and Poultry Production, pages 147 - 163

Profitable Pork Production in Missouri, pages 29; 32

Animal Science, pages 203 - 222

MU Guide 2408 "Swine Dysentery and Baby Pig Scours"

MU Guide 2406 "Atrophic Phinitis and Virus Pig Pneumonia"

MU Guide 2504 "Swine Sanitation"

		Page
Handouts:	"Some Common Swine Diseases"	261
	"Some Common Swine Parasites"	264
	"Science and Animal Health"	265

AS 65 Slides 98 - 102

MOTIVATION:

Losses from swine diseases run into millions of dollars each year.

OUTLINE:

A. Diseases
   1. Hog Cholera
   2. Erysipelas
   3. Necrotic Enteritis (Necro)
   4. Swine Dysentery
   5. Baby Pig Scours
   6. Transmissible Gastro-enteritis (TGE)
   7. Atrophic Rhinitis
   8. Virus Pig Pneumonia
   9. Leptospirosis
   10. Parakeratosis

B. Parasites
   1. Roundworms
   2. Mange
   3. Lice

C. A System of Animal Health
   1. Isolate new animals, or animals returning to the herd for three to four weeks.

   2. Put a planned immunization program into effect.

   3. Provide clean, healthful surroundings for animals.

   4. Provide rations that are nutritionally adequate.

   5. Keep visitors, dogs, birds and other animals out of the lots and buildings.

   6. Get an accurate diagnosis of the disease problem.

   7. Consult your veterinarian. Together, plan a disease prevention program.

PROCEDURES:

1. Use the handouts, "Some Common Swine Diseases" and "Some Common Swine Parasites" to acquaint students with the scope of the problem.

2. Assign each student one or more disease or parasite to learn more about and have them use the references to do so. Also have them all read "Science and Animal Health."

3. Discuss the system of animal health. Show slides 98 - 102. Have students relate how this system will prevent or control the diseases they studied. What other practices would be necessary to complete a system of swine sanitation?

4. Develop a specific plan for keeping "Johnny's" hogs healthy.

SUMMARY:

SOME COMMON SWINE DISEASES

CAUSE	SYMPTOMS	PREVENTION OR TREATMENT
	HOG CHOLERA	
Virus - Highly infectious	1. Fever and loss of appetite 2. Sticky discharge from eyes 3. Hogs prefer dark quarters 4. Loss of weight 5. Dark red or purple underside 6. Many die in 3 - 7 days	Modified live virus vaccine
	ERYSIPELAS	
Bacteria - passed in urine and feces and picked up in contaminated food and water by other hogs	Acute 1. High temperature 2. Red skin 3. Die in 3 or 4 days Chronic 1. High temperature 2. Temperature drops and diamond-shaped splotches appear on skin 3. Stiff joints - lame 4. Sluggish, easily fatigued 5. Rest on haunches	1. Serum and penicillin may be helpful in early stages 2. Segregate sick animals 3. To prevent - double treat (serum and virus) at 5 - 7 days of age. 4. Erysipelas bacteria
	NECRO	
Disease organism often found in unsanitary conditions	1. Fever, decreased appetite, diarrhea 2. Unthriftiness, slow gaining, weak, rough hair coat 3. Runt pigs	Clean ground, sanitation Antibiotics and arsenicals added to ration
	SWINE DYSENTERY	
Germ - Vibrio jejuni. The necro germ is often involved also	1. Bloody, mucous-like diarrhea 2. Dehydration, loss of weight 3. Death, 10 - 90 per cent of herd 4. Affects all age	Call veterinarian. Drug treatments are helpful if started early. Thoroughly clean premises and wait at least 30 days before introducing a new bunch of hogs

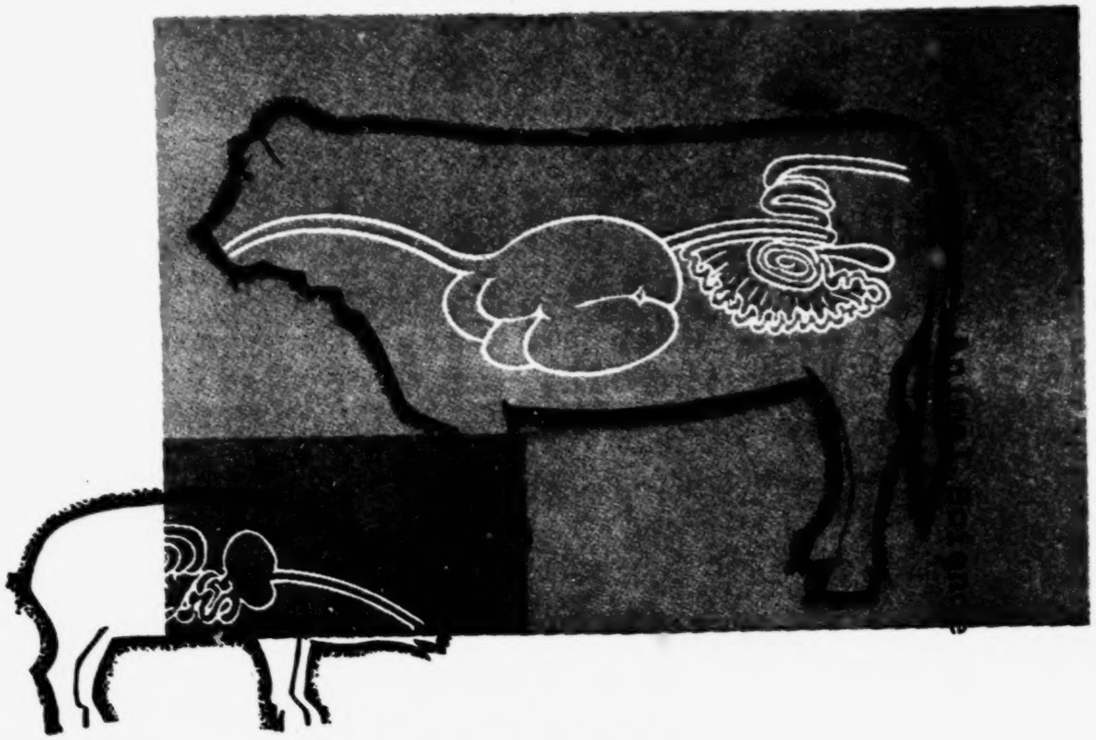
CAUSE	SYMPTOMS	PREVENTION OR TREATMENT
	BABY PIG SCOURS	
Scour producing organisms are present on most hog farms.	1. Vigorous, healthy litters usually resist the disease. 2. Weakened pigs suffer white diarrhea. 3. As infection spreads, bacteria become much more vicious.	Call veterinarian for drug treatment. Isolate sick animals. Improve husbandry to keep up resistance of pigs. Avoid continuous farrowing in the same barn.
	TGE	
Highly contagious virus. Carried on feet of men or birds.	1. Vomiting and diarrhea mostly in baby pigs. 2. It is so infectious that every pig in a barn may come down with the disease on the same day. 3. Most pigs under 10 days die.	Use antibiotics. Save sows that have lost their pigs as they will pass immunity to their future litters.
	ATROPHIC RHINITIS	
Seems to have several causes - bacteria, virus	1. Damage to tissues in the nose. 2. Sneezing, wheezing, breathing through mouth, blowing mucus from the nose, nosebleed. 3. Misshaped snout twisted, dished, shortened and thickened. 4. Slow growth, inefficient gains.	Check health of herd from which stock is purchased since individual carriers of the disease may not show symptoms. Disposal of herd may be necessary to eradicate disease.
	VIRUS PIG PNEUMONIA	
Virus destroys lung tissue. Disease lives for up to a year and virus is spread all of that time. Often complicated by roundworms.	1. Occasional coughing 2. Reduced rate and economy of gain - 10-20 per cent 3. Most hog farms have the disease. 4. More than half the hogs slaughtered show "pneumonia" lungs	Strict isolation and treatment by veterinarian of first litter to cough, thump or sneeze. Control roundworms and lung worms. Good "cold" control measures.

CAUSE	SYMPTOMS	PREVENTION OR TREATMENT
	LEPTOSPIROSIS	
Caused by bacteria May affect hogs, cattle, sheep, horses and man	1. Fever, loss of appetite, loss in weight, anemia, reduced milk flow, abortions 2. Dead pigs at birth	Call the veterinarian as soon as disease is suspected. Terramycin Vaccination - 2-3 weeks before breeding. Also vaccinate pigs to be kept for breeding purposes at weaning time.
	PARAKERATOSIS	
Improper balance of calcium and zinc in diet. Often caused by trying to reduce palatability of a supplement by adding more mineral.	1. Skin lesions, reduced appetite, slow growth, diarrhea.	Add 250 grams of zinc per ton to protein supplements or 50 grams per ton to complete rations.

SOME COMMON SWINE PARASITES

DAMAGE	TREATMENT OR PREVENTION
LARGE ROUNDWORMS	
Consume nutrients and cause digestive disturbances in intestines Damage lungs and increase complications of pneumonia Damage liver Generally weaken pigs and increase susceptibility to disease	1. Scrub sow and house before farrowing. 2. Keep pigs from dirty lots and stagnant water. 3. Rotate pastures - no hogs for 2 years. 4. Worm sows 1 - 2 weeks before farrowing and pigs soon after weaning.
LICE AND MANGE	
Lice: Suck blood from host and may spread infection. Mange Mites: Intense itching causing a red rash or scaly hide	Spray sow 30 - 45 days before farrowing to protect pigs until they are weaned. Do not treat within 30 days of slaughter.

SCIENCE AND ANIMAL HEALTH



Ask a livestock producer what his biggest problem is. He will probably say disease.

You can understand his feelings. You worry about the health of your own project animals. Disease would hurt your chances to make a profit. Your efforts to do well at an achievement show might be ruined.

Multiply your small project by the thousands of livestock producers in America. This gives you an idea of the seriousness of disease to the livestock industry.

Livestock diseases are of tremendous economic importance. The problem is important enough for state and federal government to spend millions of dollars on disease research. Governments also pass laws to control or stamp out diseases.

In addition, entire industries are devoted to developing, manufacturing and selling animal health products. They make drugs, antibiotics, insecticides, disinfectants, sanitation devices and many other products. A profession—veterinary medicine—dedicates itself to preventing and controlling animal disease.

Those working with animal health have made great strides. They now know enough to prevent, control or eliminate most diseases. It is estimated that at least three-fourths of the losses from death and lowered production could be prevented if known health practices were followed. The remaining one-fourth cannot always be prevented because we do not yet know enough about their causes.

The scientists who work in animal health have discovered certain practices which farmers and ranchers can use to prevent disease. They are commonsense ideas with good scientific principles behind them. Let's take a look at some of the practices and their scientific bases.

Source: Dr. T. W. Wickersham, Extension Animal Scientist, Iowa State University

1. Animals that you plan to add to a herd or flock should be isolated for 3 to 4 weeks. This applies to new animals. It also goes for animals that have been part of the herd but have been taken away and exposed to other animals (animals taken to shows, for instance).

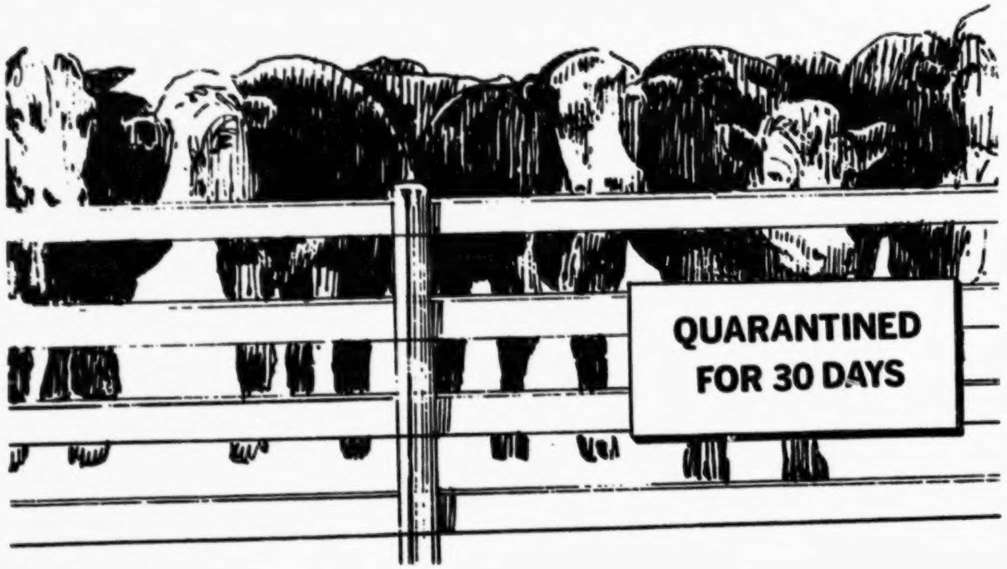
The scientific basis for this recommendation is:

Diseases are transmitted by close association or direct contact of animals. Infected animals coming into a herd could transmit the disease to the entire herd.

Disease losses can be kept low if the disease affects only a few animals instead of the entire herd. Isolation helps keep disease outbreaks confined to a few animals.

The incubation period (time it takes to show up) of most diseases is less than 30 days. If animals do not "break" with a disease in 3 or 4 weeks of isolation, chances are they are free of highly contagious diseases.

Isolation allows the farmer to better observe new animals for symptoms of disease.



The isolation period permits animals to adjust to their new environment with less "stress" than if they were immediately put with the herd.

2. Put a planned immunization program into effect.

The scientific basis for this recommendation is:

Contagious diseases are caused by microorganisms, mostly bacteria and viruses. But animals can develop defenses against many microorganisms. These defenses are the antibodies in the blood.

Vaccines cause animals to build up their antibody defenses against possible invasion by microorganisms. Each vaccine protects the animal from a specific disease.

A *planned* immunization program does not leave the protection of animals to chance. Even when there is a vaccine for a disease, vaccination must take place *before* an animal is exposed to the disease. Vaccination in most cases *after* exposure would not give the animal a chance to build its defenses. The animal would become sick. Losses would occur.

Planning a total immunization program with your veterinarian is the most scientific way to prevent the diseases for which there are vaccines. Planning involves doing, too. Unless the animals are actually vaccinated on time, with the right vaccine and by the best method, immunity will not be achieved.

3. Provide, clean, healthful surroundings for your animals.

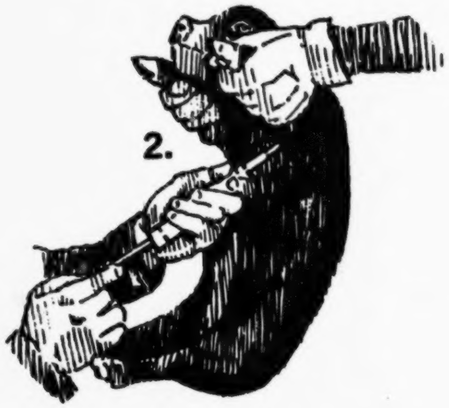
The scientific basis for this recommendation is:

Disease organisms often grow in organic waste which has not been cleaned up. Removing the source (reservoir) of the disease organism lessens the chances of disease.

As animals' environment is improved, their performance will improve. Clean, healthful surroundings promote better performance because of less stress from disease. The animals' bodies are not constantly fighting disease.

The most dangerous source of disease is a diseased animal itself. Diseased animals should be quarantined from the herd. The pens and yards where they have been should be thoroughly cleaned. This is to prevent the spread of the disease.

2.



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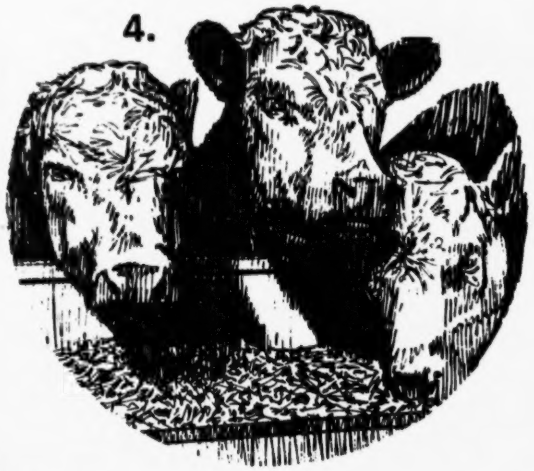

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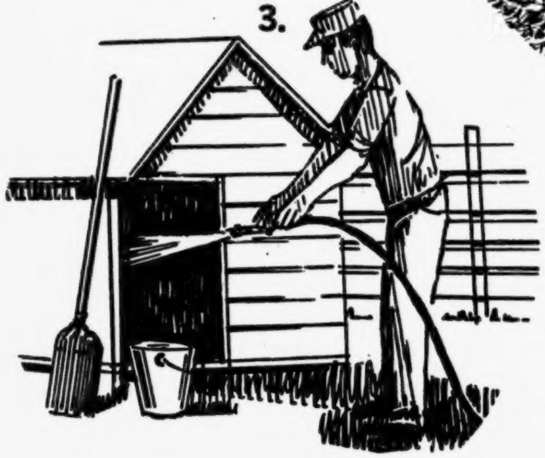


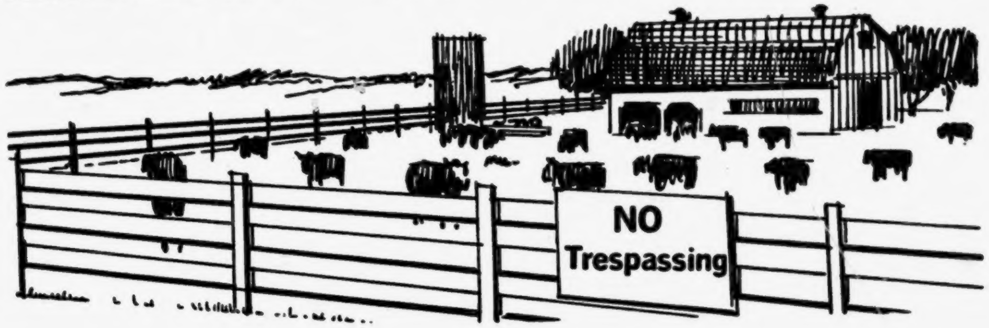
4. Rations must be nutritionally adequate.

The scientific basis for this recommendation is:

Some diseases are caused by deficiencies of certain nutrients. No microorganism is involved. Various deficiencies can cause body abnormalities, infertility, abortion and many less noticeable malfunctions.

Animals have more disease resistance if their rations are adequate. An animal's general well-being depends largely on its nutrition. The better the nutrition, the better the body defenses against diseases will be. (Remember the best nutrition does not necessarily mean the most fattening ration.)

Rations can cause health problems other than deficiencies and increased susceptibility to disease. Overfeeding can cause problems. For example, an overly fitted beef heifer will sometimes be infertile simply because she has been fed more than she needs. Her reproductive tract could be said to be in unnatural or "unhealthy" condition.



5. Keep visitors, dogs, other animals and birds out of the livestock lot and houses.

The scientific basis for this recommendation is:

Diseases are transmitted in many ways. They may be carried on the boots, shoes and clothing of people; by the feet, hair, feathers and feces of birds and other animals.

As the traffic in and out of livestock lots is reduced, so are the chances of transmitting disease.

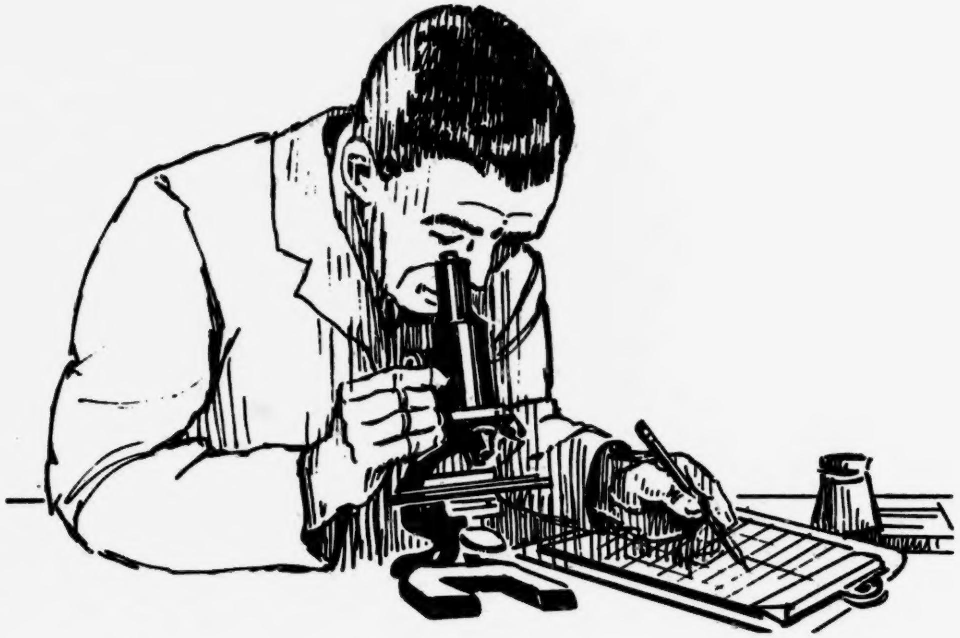
Disease can be carried *away* from livestock lots as well as to them. A good livestock man wants to prevent his animals from infecting others just as he wants to stop others from infecting his.

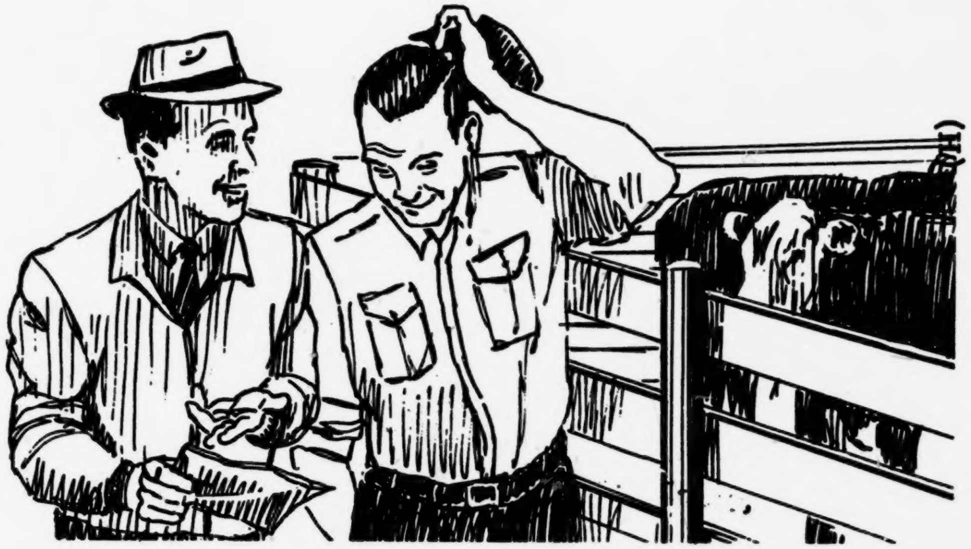
6. Get an accurate diagnosis of the disease problem.

The scientific basis for this recommendation is:

Correct diagnosis of the disease is necessary before it can be treated. The symptoms of several diseases may be very similar. A wrong diagnosis would result in the wrong treatment. Loss would result.

A diagnosis requires much specialized knowledge and many procedures. Veterinarians have this knowledge and can accurately identify most diseases. Many veterinarians have their own laboratories. In addition, they are backed by state diagnostic laboratories and the laboratories of commercial drug companies. Veterinarians rely on these laboratories to help diagnose difficult cases. They know it takes skilled scientists to identify a disease.





7. Consult your veterinarian. Together, map a disease prevention program.

The scientific basis for this recommendation is:

Preventing disease is more effective than treating animals after they become sick.

Your local veterinarian is best qualified to help outline a disease control program. He is trained in his field. And he knows the disease problems on neighboring farms.

If you consult your veterinarian all along, he will know the history of your herd in case of a disease outbreak. He will be in a better position to make an accurate diagnosis.

Disease prevention will probably be more effective when the herd owner and the veterinarian work together in all phases of the herd health program.

Lesson 6. Providing Housing and Equipment for the Sow and Litter (2 days)

OBJECTIVES:

1. To become familiar with facilities used in producing pigs.
2. To understand how differences in housing systems relate to different schemes for raising hogs.

REFERENCES:

Livestock and Poultry Production, pages 99 - 100; 124, 127, 139, 141 (Pictures)

Profitable Pork Production in Missouri, page 16

Catalog of Plans for Livestock Equipment

Catalog of Swine Building and Equipment Plans

Animal Science, pages 834 - 835

		Page
Handouts:	"Permanent vs. Portable Housing"	271
	"Swine Growing and Finishing Facilities"	272
Transparencies:	"Shelter and Feeder Space For Swine"	273

MOTIVATION:

Investment in housing for hogs varies from practically nothing to thousands of dollars. Why would anyone spend several thousand dollars for a hog raising set-up?

OUTLINE:

A. Management Systems

B. Housing for Farrowing
   1. Central
   2. Portable

C. Housing for Growing - Finishing Hogs

D. Equipment Needs
   1. Feeders
   2. Waterers

3. Sprinklers
4. Feeding floors
5. Shade

PROCEDURES:

1. Show pictures of some typical portable and central houses.

2. Hand out "Permanent vs. Portable Housing."

3. Discuss advantages of portable and central housing.

4. Hand out "Swine Growing and Finishing Facilities."

5. Show pictures and discuss equipment items needed.

6. Show "Shelter and Feeder Space for Swine."

7. Decide precisely what arrangements "Johnny" needs to make for facilities needed.

SUMMARY:

PERMANENT VS. PORTABLE HOUSING

	Investment per Sow		Annual Use Cost per Sow	
	Portable Housing	Permanent Housing	Portable Housing	Permanent Housing
Farrowing	$ 57	$ 91	$ 7.31	$ 8.46
Nursing	47	49	6.14	4.98
Growing and Finishing	119	131	14.57	12.83
Sow Shelters	23	23	3.00	3.00
Total	$246	$294	$31.02	$29.27

48 sows, 2 litters, 2 groups, alternate months of farrowing spring and fall.

SWINE GROWING AND FINISHING FACILITIES

	System				
Per hog cost	A Conventional	B Enclosed 4x14 pens	C Enclosed concrete floor	D Enclosed Slotted	E Conventional pasture
Build & equip. (3 grp)	$ .78	$ 1.79	$ 1.54	$ 1.82	$ .96
Feed (150 lb. gain)	15.31	14.63	15.65	15.73	14.61
Labor for cleaning & bedding	1.20	.08	.90	.00	.90
Other labor	.80	1.00	1.20	1.20	1.00
Bedding	.40	.00	.00	.00	.55
Death loss & injury	.27	.27	.92	1.11	.54
Vet. & medicine	.14	.18	.47	. 56	.18
Other	.89	1.16	1.16	1.16	.85
Total	$19.79	$19.11	$21.84	$21.58	$19.59
Invest. per 200# hog	18.00	44.00	31.00	38.00	15.00

Feedstuffs, "Which Type of Swine Growing-Finishing Facility?"

SHELTER AND FEEDER SPACE FOR SWINE

Size of Hog	Summer Time Shade or Housing	Winter Time Housing	Hand Feeding or Watering
Weaning to 75 pounds	7 sq. ft.	6 sq. ft.	.75 ft.
76 to 125 pounds	9 sq. ft.	8 sq. ft.	1.00 ft.
126 pounds to market	12 sq. ft.	10 sq. ft.	1.25 ft.
Gilt or Junior Boar	17 sq. ft.	15 sq. ft.	
Sow or Mature Boar	20 sq. ft.	18 sq. ft.	

AGRICULTURAL MECHANICS I

SUBUNITS:	Days Systematic Instruction	 Shop Exercises	Pages
1. Using Hand Woodworking Tools	2	5	3
2. Woodworking	3		7
3. Arc Welding	3	8	17
4. Gas Engines	8	7	39
5. Farm Service Center	2		53
6. Painting	1	1	55
7. Tool Sharpening	2	3	57
Total	21	24	

Material in this section was prepared by:

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and

Richard Linhardt, Instructor in Agricultural Engineering
University of Missouri

Subunit: Using Hand Woodworking Tools

Lesson: Use of Handsaws and Planes

OBJECTIVE:

To teach students the proper method of using handsaws and planes.

REFERENCES:

Shop Work on the Farm, pages 58-80; The Farm Shop, pages 237-249.

MOTIVATION:

The proper method of using a handsaw is not difficult to learn and should be learned before anything is built in shop. A particular type saw should be sued for a specific job.

STUDY OR DISCUSSION QUESTIONS:

1. What are the common types of woodworking saws?
2. What is the difference between the rip saw and the cross cut handsaw?
3. How should the saw be held?
4. How should the saw be started?
5. How can splintering be avoided when finishing the cut?
6. What procedure is used to check to see that the cut is straight and square?
7. What angle is the saw held in crosscut sawing? Ripping?
8. How are curves sawed?
9. When is a miter box used in sawing?
10. What side of the line should the saw cut be made?
11. How should a coping saw be used?
12. What are the three most common types of wood planes? How can they be distinguised?
13. How can the hand plane be adjusted?

14. List the main parts of a plane.
15. In planing, of what significance is the grain of the wood?

SUMMARY OF INFORMATION:

1. Crosscut handsaw, rip handsaw, coping saw, compass saw.
2. Number of teeth, set, and shape.
3. Handle should be grasped firmly, the forefinger should extend along the side of the handle for guiding the saw. Stand back from the work a little and in a position so that a line across the chest and shoulders are at an angle of about 46 to 60 degrees with the line of sawing. The saw arc, elbow, shoulder, and right eyes all should be in the same vertical plane.
4. Grasp the edge of the board with the left hand, using the thumb to guide the saw. Make two to three backstrokes, lifting the saw on the forward stroke, draw the saw back slowly and carefully until it is guided into the position the cut is to be made.
5. The outer end of the board should be supported by the left hand and finishing cuts should be made slowly and with light strokes.
6. The work can be checked by using the square onside of the board, the other leg of the square against the saw.
7. Crosscut 45 degrees, ripping 60 degrees.
8. The compass saw is often used for inside curves. For small circles and steep curves the coping saw is used.
9. A miter box is used for squaring stock and cutting angles from 90 degrees to 45 degrees in either direction.
10. Beside the line in the waste material.
11. The blade may be inserted to cut on either the pull or push stroke. Long, steady, moderately slow strokes should be used to keep from kinking or overheating of the blade.
12. The smooth plane, jack plane, jointer plane.

13. Hold the plane, upside down, and slight along the bottom. Turn the adjustment nut until the cutting edge protrudes through the bottom of the plane about 1/64 inch. Then set lateral-adjusting lever until the cutting edge is parallel with the bottom of the plane. Re-adjust the depth of cut according to the hardness of the wood and the amount of cut to be made.

14. Plane iron cap, plane iron, lateral adjustment lever, handle adjusting nut, heel, plane bottom, frog, mouth, toe, iron, lever, cap screw, cap iron screw, lever cap, cam.

15. The plane should always cut out of the grain instead of cutting into it.

TEACHING SUGGESTIONS:

Demonstrate in shop the proper method for holding a saw, starting the cut, the angle of the cut, the side of the line to saw, etc.

Demonstrate in shop the procedures for adjusting a plane and how to hold the plane to smooth wood.

Subunit: Woodworking

Lesson: Using Measuring Devices

OBJECTIVE:

To teach students to become proficient in measuring and marking with the common measuring tools used in woodworking.

REFERENCES:

Shopwork on the Farm, pages 43-58; The Farm Shop, pages 215-226.

TOOLS NEEDED:

Carpenter's steel square, combination square, pocket tape, folding rule, zigzag type folding rule, 2-foot folding rule, and bevel.

MOTIVATION:

One of the first requirements in project construction is that the worker be proficient in using the common measuring devices. Hold up individual measuring tools and have students attempt to name them.

STUDY OR DISCUSSION QUESTIONS:

1. List and name correctly the various measuring tools in the classroom.
2. How should one lay off several measurements in a straight line?
3. What procedure is used in marking the middle of a board?
4. What are the different uses of a combination square?
5. How is a steel square used in laying off angles?
6. How can a steel square be checked for "trueness"?
7. What kind of pencil is desirable for marking on wood?
8. When would one use a bevel?
9. When considerable guaging is done what tool would be most desirable?

10. How is a divider used in measuring?

11. When is the chalk line used in marking?

12. What is a plumb bob? When is it used?

13. When is the level used in measuring?

SUMMARY OF INFORMATION:

1. Carpenter's steel square, combination square, pocket tape, folding rule, zigzag type folding rule, 2-foot folding rule, marking gauge, bevel, level, plumb bob, and chalk line.

2. To lay off several measurements in a straight line, it is best to mark off all measurements without raising the rule. If each measurement is made separately, errors are compounded.

3. Place the rule across the board at an angle so that the magor divisions on the rule coincide with the edges of the board. Mark midway between the two major divisions.

4. Measuring, marking, laying out, and checking the squareness of work.

5. Place the square with the tongue along the end of the board, note the readings where both the tongue and body of the square touch the edge of the board. Keeping in mind these numbers the same angle can be duplicated on another board.

6. Use a board with a perfectly straight edge, mark off a right angle to the edge of the board, turn the square over and see if the line still checks square. If not, square is not true.

7. A hard pencil makes a finer line and stays sharp longer.

8. The bevel is used for laying out and checking angles and bevels.

9. Where considerable accurate guaging is to be done, a marking guage is desirable.

10. Dividers are used for marking out circles, for transferring short measurements, and dividing distances into a number of equal parts.

11. The chalk line is a simple and quick method of marking a straight line on a floor, wall, ceiling, or a piece of lumber.

12. A plumb bob is a pointed weight that is suspended by means of a cord. It is used in connection with a square for establishing a level line.

13. The level is used for marking level lines, for placing the surface of a board in a level plane, and to level foundation forms, part of a machine, etc.

TEACHING SUGGESTIONS:

The instructor or students should demonstrate different measuring tools in shop. Pass tools around to students so they can become familiar with them.

Subunit: Woodworking

Lesson: Boring and Drilling

OBJECTIVES:

To have the students learn the kinds of wood boring and drilling tools. To teach the use of each of the tools.

REFERENCES:

Shopwork on the Farm, pages 92-113; The Farm Shop, pages 252-258.

MATERIALS:

Auger bit, twist drill, countersink, expansive bit, Forstner, screwdriver bit, bit brace, hand drill, push drill, electric drill.

MOTIVATION:

Hold up different kinds of bits, ask students the name and use of each.

STUDY OR DISCUSSION QUESTIONS:

1. List the various methods of boring and drilling wood.
2. What procedure is used for locating the point of a bit?
3. How can splintering be avoided when boring through wood?
4. How can the depth of the hole be determined?
5. What procedure should be followed when drilling in wood with a twist drill?
6. How can one check to see if the drill is square with the surface of the wood?

SUMMARY OF INFORMATION:

1. Auger bit, expansive bit, forstner bits, bit-stock drill, countersink, screwdriver bit.
2. First mark the location for the center of the hole, by the intersection of two cross lines, or by using an awl or other pointed instrument. Then, guide the point of the bit carefully into place.

3. Bore until the point of the bit can be felt on the other side of the board, turn board over and complete the boring from the opposite side. It is often helpful to clamp two pieces of board together, so splinter will occur in scrap board in back.

4. Stop turning as soon as cutting lips touch wood, measure the distance from the end of the chuck to the surface of the piece bored. Bore until the measurement on the rule is decreased by the desired amount.

5. When drilling with a twist drill, remove the drill bit frequently so bit is cleaned and cooled.

6. One can sight from two directions or check with a square at two points 90 degrees apart.

TEACHING SUGGESTIONS:

Demonstrate the drill or boring in wood with the various bits.

Subunit: Woodworking

Lesson: Fasteners

OBJECTIVES:

To teach students different ways of fastening wood. To teach the students the names and sizes of the different types of fasteners.

REFERENCES:

Shopwork on the Farm, pages 98-112; The Farm Shop, pages 258-265.

MATERIALS:

Common nail, box nail, casing nail, finishing nail, bell face hammer, plain face hammer, flathead screw, oval head screw, round head screw, animal glue, casein glue, cold liquid glue.

MOTIVATION:

How many different ways can wood be fastened? Hold up each of the different methods and discuss them briefly.

STUDY OR DISCUSSION QUESTIONS:

1. Name the two different kinds of hammers. What is the specific use of each of the hammers?
2. How is the size of a hammer determined?
3. Name 4 kinds of nails and be able to identify them.
4. How can splitting of a board be avoided when nailing?
5. Where is draw nailing used?
6. Name the kinds and sizes of wood screws. What are the parts of a screw?
7. How do you determine the size hole to drill for a wood screw?
8. When is countersinking done? Counter boring?
9. Name 3 kinds of glue and give the specific use of each.
10. Give the procedure for gluing.

SUMMARY OF INFORMATION:

1. Bell-face and plain-face hammers. Bell-face hammers are used to drive nails up tight with their head flush or slightly below the surface of the wood.

2. The size of the hammer is designated by the weight of the head exclusive of the handle.

3. Common nail, box nail, casing nail, finishing nail.

4. Nail through a thin piece into a thick one, drive nails across grain, use a small nail, use a chisel shaped point, drive chisel point nail so that the fibers of the grain is cut, cut nails off square before driving.

5. Where it is desired to make a tight joint between two boards.

6. Flathead screws, oval head screws, round head screws. Size of screw is designated by the gage number and length.

7. Drill the hole through the first piece the size of the shank of the screw, drill the pilot hole in the second piece the size of core or body of the screw under the threads.

8. When flathead screws are used countersinking is required. When round or oval head screws are used and the head is to be below the surface of the wood, counter boring is done.

9. Animal glue-strong bond, must be heated. Casein glue-stong water resistant, easily prepared. Cold liquid glue-not as strong but is already prepared, ready for use.

10. Parts to be glued must fit properly, all clamps, material must be ready before applying the glue. Apply glue thoroughly to all parts and brush it in, clamp pieces together.

TEACHING SUGGESTIONS:

Pass different fasteners to students so they can study them.

Subunit: Woodworking

Lesson: Chisels

OBJECTIVE:

To teach students the proper use of woodworking chisels.

REFERENCES:

Shopwork on the farm, pages 82-89; The Farm Shop, pages 249-252.

MOTIVATION:

How many uses can you name for a wood chisel?

STUDY OR DISCUSSION QUESTIONS:

1. List the procedure for chiseling with the grain.
2. List the procedure for chiseling across the grain.
3. How is a "dado" made with a chisel?
4. What is "gaining"? How is it accomplished?

SUMMARY OF INFORMATION:

1. Always cut with the grain, to avoid splitting. Fasten the work in a vise when possible, so both hands are free to work with the chisel.

   Always push the chisel from you, keep hand from in front of the cutting edge.

   Use the chisel with the bevel down for roughing cuts and with the bevel up for fine paring or finishing cuts.

   Hold the handle slightly to one side to give an oblique cutting action which makes an easier cut.

2. If much material is to be removed, make a roughing cut first, leaving about 1/16" to be removed with the finishing cut.

   Guide the chisel with the left hand.

   Use about half the width of the chisel for cutting on each new stroke.

If the chisel is to cut through or across the piece, place a scrap piece in back so the chisel will not cut into the bench.

3. A dado is a groove that runs across a board to receive the end of a board. The first step in making a dado is to mark it off accurately. After marking, saw just inside the lines in the waste material to the proper depth. Then chisel out the waste. Filing or sandpapering may be used in finishing up the dado.

4. Gaining is notching into a piece to fasten a second piece securely. To make a gain, mark out accurately the width and depth. Then saw inside the mark in the waste material to the depth. Chisel out the waste in the same manner as the dado.

Subunit: Arc Welding

Lesson: Become familiar with the Arc Welder

OBJECTIVE:

To understand what happens when two pieces of metal are welded together. To understand the welding circuit.

REFERENCES:

Farm Welding, pages 1-4; Shopwork on the Farm, pages 478-479; Arc Welding Lessons, pages 1-8. Make sure main switch is disengaged or welder unplugged before showing students welding equipment. Point out to the students that they will be working with 240 volt equipment.

MOTIVATION:

Compare the spark in an ignition system to the welding process.

STUDY OR DISCUSSION QUESTIONS:

1. What voltage is required for the 180 ampere welder?
2. What happens when you strike an arc with the welder?
3. What is the purpose of the electrode or welding rod?
4. Trace the electrical current from the power supply line to the electrode or welding rod.
5. What are the following?
    a) Electrode holder
    b) Ground clamp
    c) Base Metal
    d) Slag
    e) Penetration
    f) Crater
    g) Electrode
    h) Molten Puddle

SUMMARY OF INFORMATION:

1. 230 volts.

2. A heavy current is made to flow across the gap between the electrode and the metal being welded.

3. The heat of the arc that spans the gap is so intense that it creates a crater of molten metal, also melts small globules of metal from the end of the electrode and deposits them along the joint making a weld.

4. Current flows from the power line, to the transformer, to wall outlet to the primary winding, induced to the secondary winding, to the electrode holder and finally to the electrode.

5. Electrode holder-connects the welding cable to the electrode.

   Ground Clamp-connects the ground cable to the work on the welding table to complete the circuit.

   Base Metal-metal being welded.

   Slag-is formed over the weld metal protecting it from oxidation while the weld cools. The electrode coating contains a flux to improve the flowing qualities of the molten metal and makes the arc easier to control. This coating forms the weld slag.

   Penetration-depth of the weld.

   Crater-a depression at the end of an arc weld bead, caused by the force of the arc as it is withdrawn.

   Electrode-metal rod or wire which conducts current from the electrode holder through the arc to the base metal.

   Molten Puddle-the molten metal as a result of the arc.

TEACHING SUGGESTIONS:

1. Take students to shop and show them the welding equipment.

2. Show students the path the electrical current follows.

3. Point out the electrical circuit in Shopwork on the Farm, page 482.

Subunit: Arc Welding

Lesson: Striking the Arc and Running Beads

OBJECTIVES:

1. To observe safe practices when welding or working near welding area.
2. To develop ability to strike an arc and maintain correct arc length.
3. To develop ability to prepare materials for welding.

REFERENCES:

Shopwork on the Farm, pages 491-500; Farm Welding, pages 20-36; Arc Welding Lessons, pages 96-104, 121-129.

MOTIVATION:

Discuss with students the intense light rays given off by an arc welding, resulting in burns to the skin and eyes.

STUDY OR DISCUSSION QUESTIONS:

1. What safety precautions should be followed when welding?
2. What methods can be used to strike an arc?
3. What is the purpose of correct arc length?
4. How does rate of travel effect the metal deposit?
5. What effect does welding current have upon metal deposit?
6. How can electrode weaving be used to deposit metal?
7. What are the typical joints used in welding?
8. How should metal be prepared for welding?

SUMMARY OF INFORMATION:

1. Avoid shock hazards, wiring should be done in an approved and safe manner. Always use a face or head shield that is in good condition, never look at the arc with the naked eye. Wear protective clothing. When chipping slag wear goggles. Provide proper ventilation. Do not weld around inflammable materials. Always weld in a dry area. Do not pick up hot metal.

2. The scratching method and the tapping method.

3. The proper length of the arc may be judged by the appearance of the arc, the appearance of the weld and the sound of the arc. In general, use a short arc, but not so short that the coating of the electrode touches the metal.

4. Moving the electrode too slow builds the metal up too high, resulting in wide, and overlapping beads. Moving too fast gives an irregular flat and poor penetration. The crater should be 1 to 1½ times the diameter of the electrode. An electrode should produce a bead approximately equal to its length.

5. Too low a current gives shallow penetration and a high bead not fused adequately into base metal. Too high high a current penetrates too deeply, makes a wide crater, with undercutting at the edges, and thus tends to produce spatter with burn through.

6. Weaving is done to produce a wider bead than would be possible without weaving. Weaving the electrode keeps the metal molten a little longer and allows the gas to escape and the slag to come to the surface, and avoids some of the porosity in the weld.

7. Kinds of joints are: lap, tee, corner, and edge. Welds in general may be classified as bead, groove, and fillet.

8. The work should be cleaned of rust, scale or other foreign material before welding. Thin parts (1/8-inch and under) may generally be placed together and welded without beveling the edges, but thicker parts should be beveled or vee'd out to insure adequate penetration.

TEACHING SUGGESTIONS:

1. Let students practice weaving motions on paper by using a pencil held in a pair of pliers.

2. Let students practice striking an arc.

3. Prepare a panel board of various types of welds, both good and bad.

Subunit: Arc Welding

Shop Exercise: Starting the Arc.

OBJECTIVES:

1. To learn to strike an arc and maintain it without sticking or getting arc too long.
2. To learn to judge arc length and correct heat by sight and sound.

REFERENCES:

Shopwork on the Farm, pages 494-500; *Farm Welding*, pages 24-28; *Arc Welding Lessons*, pages 112-123.

AVERAGE PRACTICE:

One Period.

PRACTICE MATERIAL:

3/16" mild steel plate.

ELECTRODE:

1/8" AWS, E6011

AMPERAGE SETTING:

95 to 100 Amps.

ELECTRODE POSITION:

Perpendicular for striking arc and 15 to 20 degree lead in direction of travel after the arc is established.

PROCEDURE:

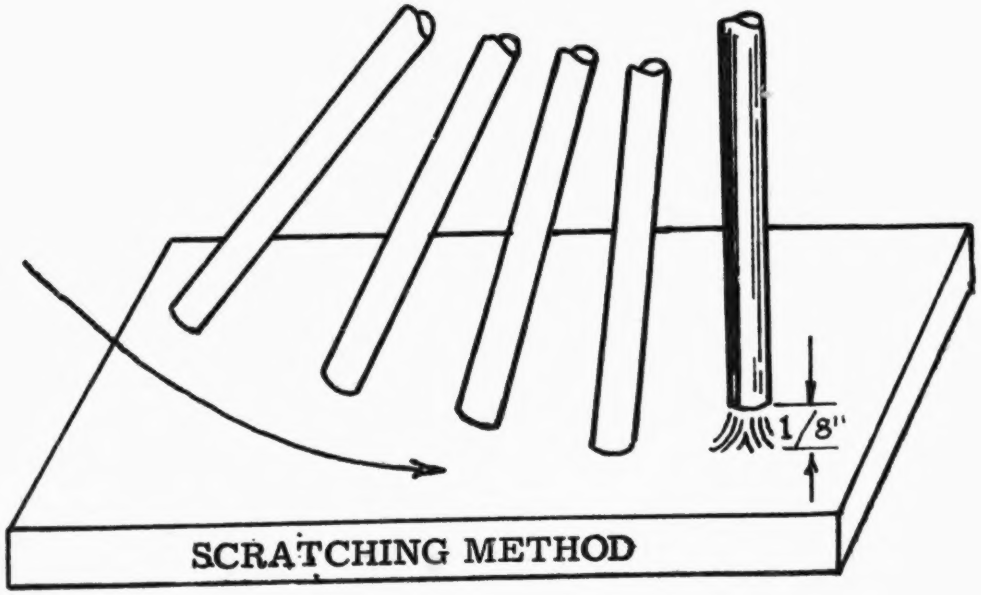
Read references carefully before starting exercises in shop. Strike an arc using the scraping method and then the tapping method. Observe the difference in the sound of a long and short arc and also the effect upon the bead formed. Try very low and very high amperage settings on the machine and notice the difference in sound of arc. Use a piece of 3/16" scrap approximately 4" x 7". Start at left side and top edge of plate, strike an arc and run a bead 1" long, break arc, then restrike arc and lay another 1" bead. Continue laying 1" beads until ½ of plate has been covered.

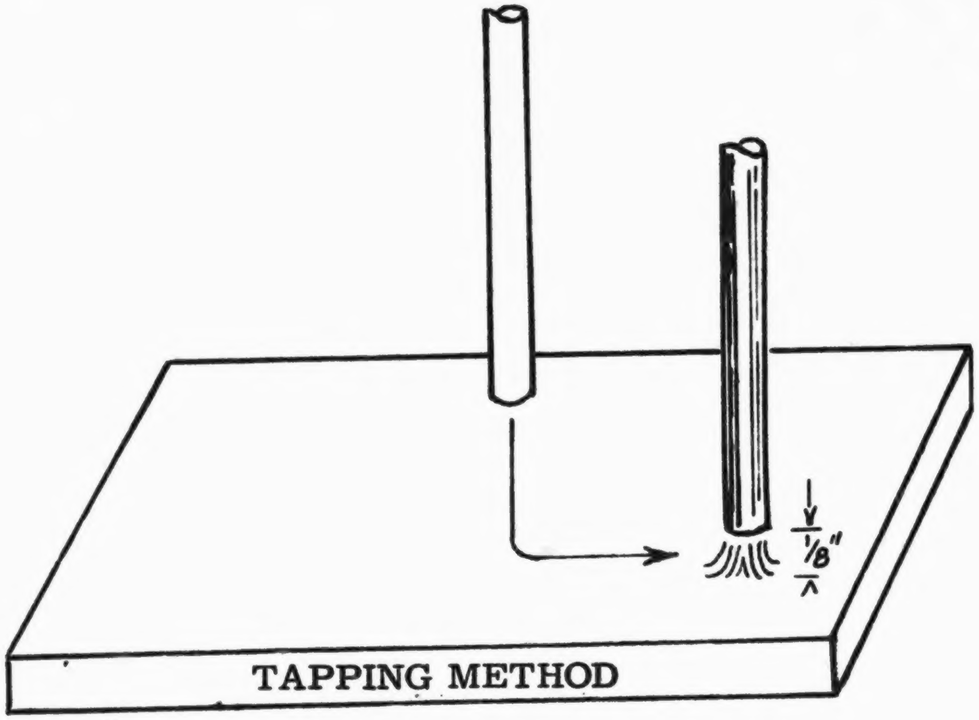
Turn plate 90° and work away from you and back with 1" beads on remaining half. Remove slag with chipping hammer, being sure eyes are protected with goggles when chipping slag from welds. Clean welds with wire brush before turning work in for grading. When one side of plate is completed, turn over and repeat the above procedure.

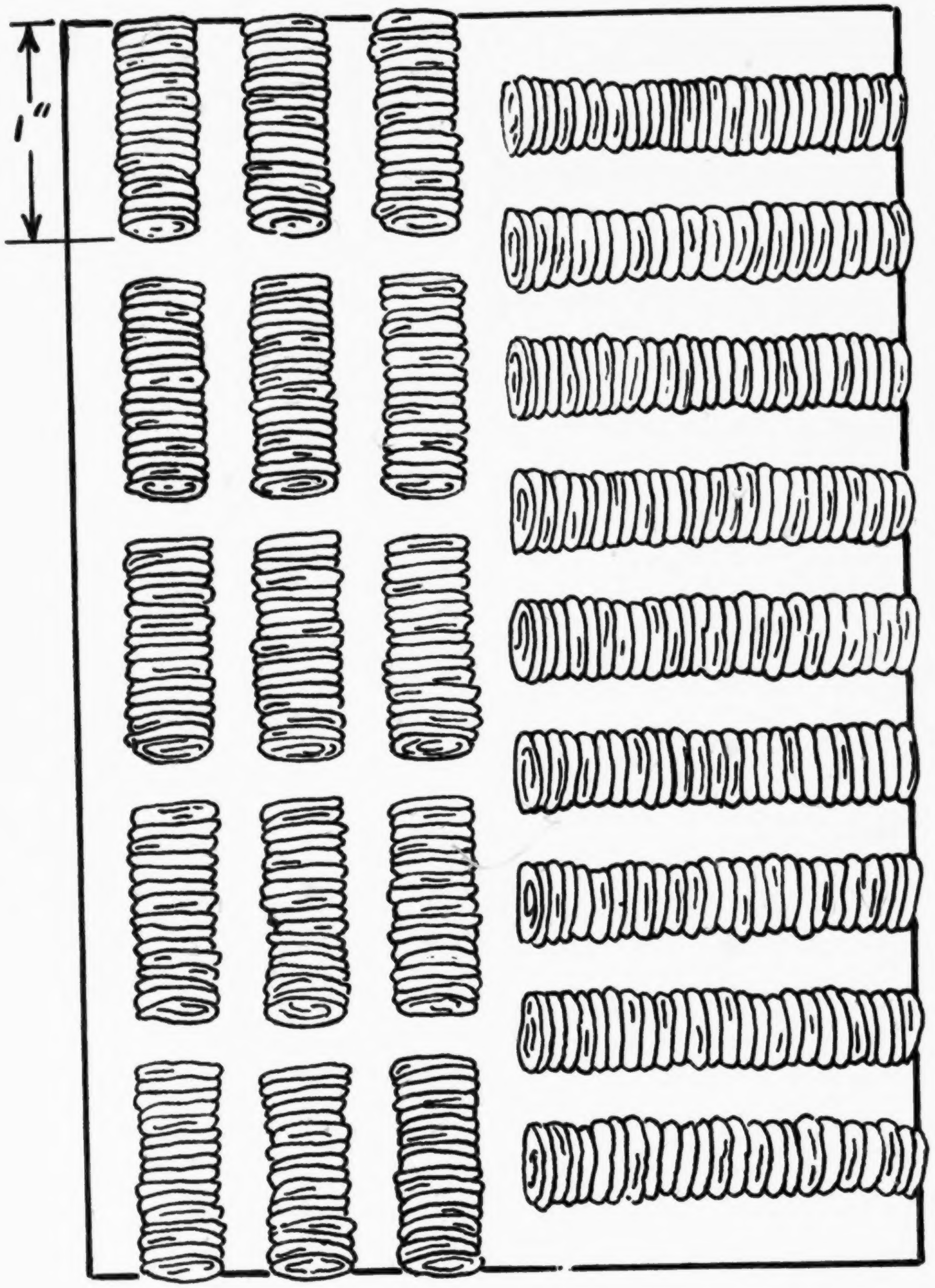
THINGS TO REMEMBER:

1. Discard electrode when 1-½" long.
2. Place discarded electrodes in container.
3. Never strike an arc until eyes are protected with welding helmet.
4. Keep sleeves down and wear gloves.
5. Handle hot metal with tongs.
6. Clean welding area and place scrap in container.

Striking an Arc and Running a Bead


1/8"
SCRATCHING METHOD


1/8"
TAPPING METHOD



Subunit: Arc Welding

Shop Exercise: Basic Manipulation of the Arc.

OBJECTIVES:

1. To become proficient at laying long uniform beads accurately without breaking the arc.
2. To develop the ability to properly adjust amperage and judge proper rate of travel.

REFERENCES:

Arc Welding Lessons, pages 123-129; Farm Welding, pages 28-30.

AVERAGE PRACTICE:

One Period.

PRACTICE MATERIAL:

3/16" mild steel plate.

ELECTRODE:

1/8" AWS, E6012 or E6013

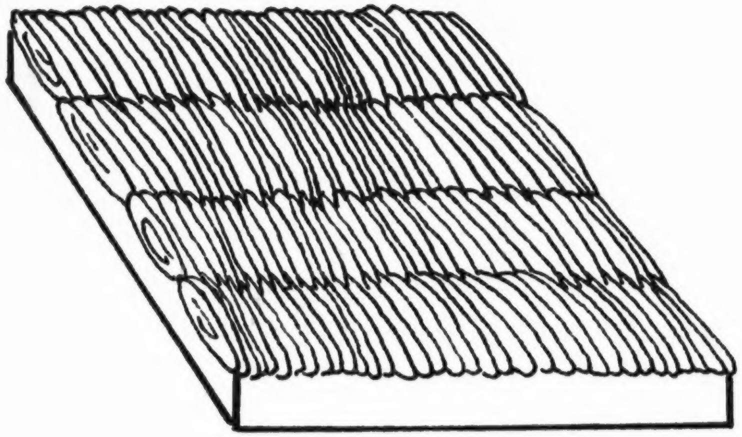
ELECTRODE POSITION:

15 to 20 degree lead in direction of travel.

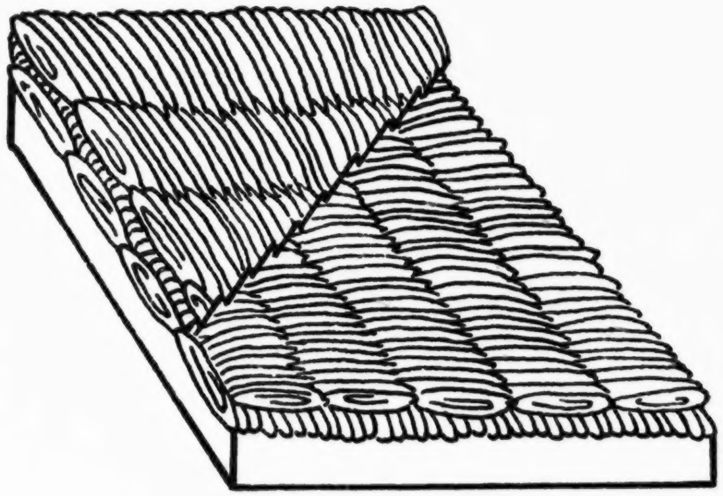
PROCEDURE:

Study reference and illustration carefully before starting to practice. Starting at left hand corner away from you, lay a bead along the edge from left to right. Clean slag from the bead and lay another beside it fusing 1/5 of its width into the previous bead. Learn how to properly start new electrode in crater formed by previous electrode. When plate is covered with one layer, turn plate over and repeat same procedure. When back of plate is covered with one layer turn plate 90° and deposit a second layer of beads, a third, and so on. When you can weld from left to right, then try from right to left, then working away from you and then toward you.

Basic Manipulation of the Arc



SINGLE LAYER



MULTIPLE LAYER

Subunit: Arc Welding

Shop Exercise: Butt Welding in Flat Position.

OBJECTIVE:

To acquire skill in making various types of butt welds.

REFERENCES:

Farm Welding, pages 38-48; Shopwork on the Farm, pages 500-506; Arc Welding Lessons, pages 137-149.

AVERAGE PRACTICE:

One Period.

PRACTICE MATERIAL:

3/16" mild steel plate, ½" bar stock scrap round stock.

ELECTRODE:

1/8" AWS, E6011

AMPERAGE SETTING:

90 to 100 amps.

ELECTRODE POSITION:

15 to 20 degree lead in direction of travel.

PROCEDURE:

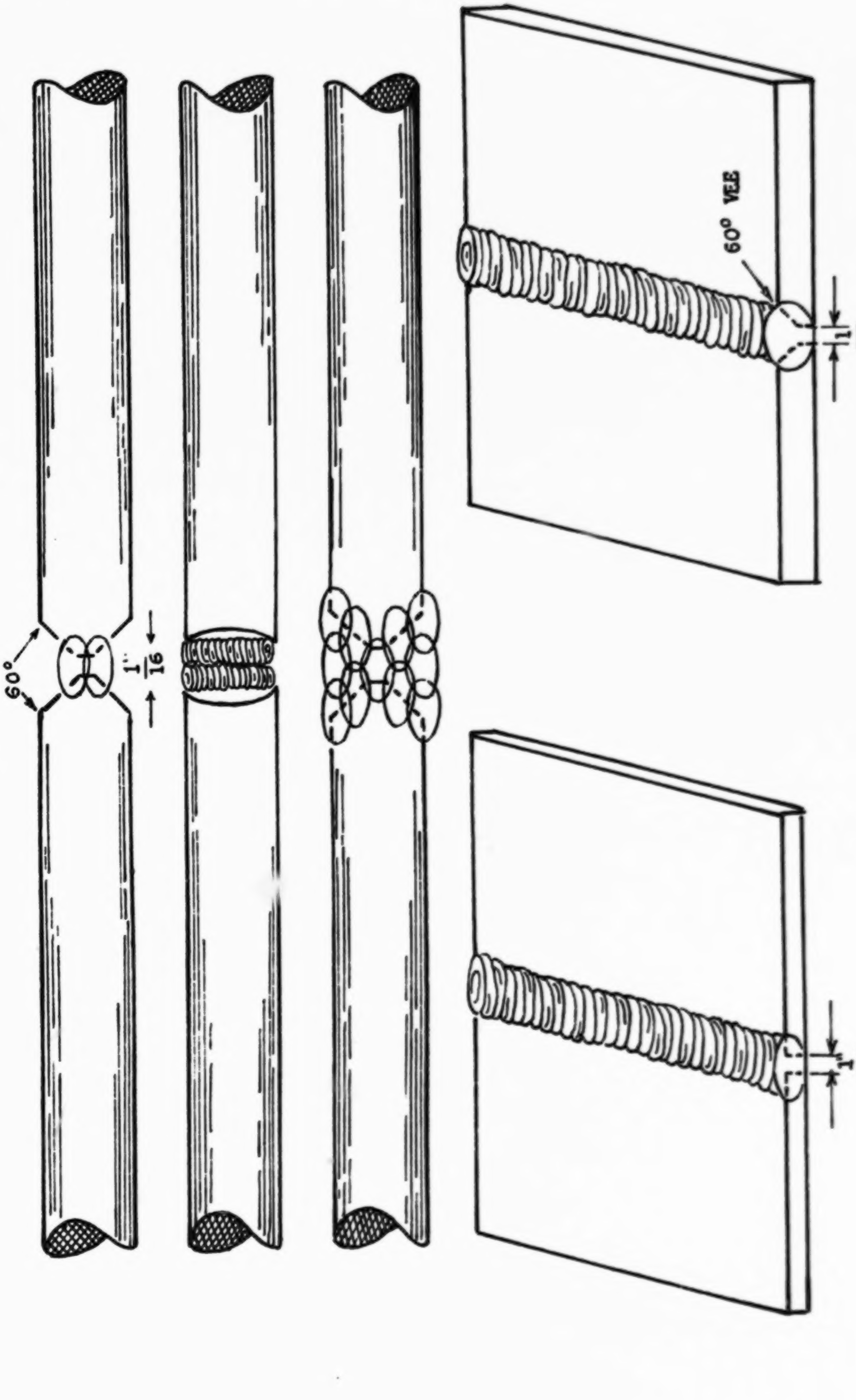
On sheet steel 1/8" thick or less, leave about 1/16" space between pieces for good penetration and fusion. Pieces should be tack welded at each end to hold firmly in place. On pieces 3/16" to 3/8" thick, one or both pieces should be beveled to form a 60-degree angle. On stock 3/8" and larger both sides should be beveled and welded from each side. On round stock, bevels should be on alternate sides with 1/8" space left between pieces.

THINGS TO REMEMBER:

1. Clean all slag from tack welds before running beads.
2. Chip slag from work, making sure eyes are protected with goggles.

3. Greater strength can be obtained by two methods:
    a) Heat to bright red heat and hammer with heavy blows.
    b) Heat to bright red heat and let cool slowly.
4. Dipping weld in water weakens weld and causes cracking also develops poor grain structure of welded metal.

Butt Welding in Flat Position


60°
1"/16
60° VEE
1"/16
1"/16

Subunit: Arc Welding

SHOP EXERCISE: Fillet Welding in Horizontal and Flat Position.

OBJECTIVE:

To learn to control the arc for fillet welding in flat and horizontal position.

REFERENCES:

Farm Welding, pages 49-60; *Shopwork on the Farm*, pages 506-508; *Arc Welding Lessons*, pages 150-162.

AVERAGE PRACTICE:

One period.

PRACTICE MATERIAL:

Scrap mild steel plate.

ELECTRODE:

To be selected by the student.

AMPERAGE SETTING:

Farm Welding, page 51; *Arc Welding Lessons*, page 155; *Shopwork on the Farm*, page 495, refer to selding charts.

ELECTRODE POSITION:

See reference.

PROCEDURE:

Make a fillet tee weld using pieces of equal thickness, making one bead on one side and three beads on other side. Make a fillet tee weld using pieces of unequal thickness. Make a lap weld using scrap from previous exercises. Using tee welded pieces run beads in horizontal position.

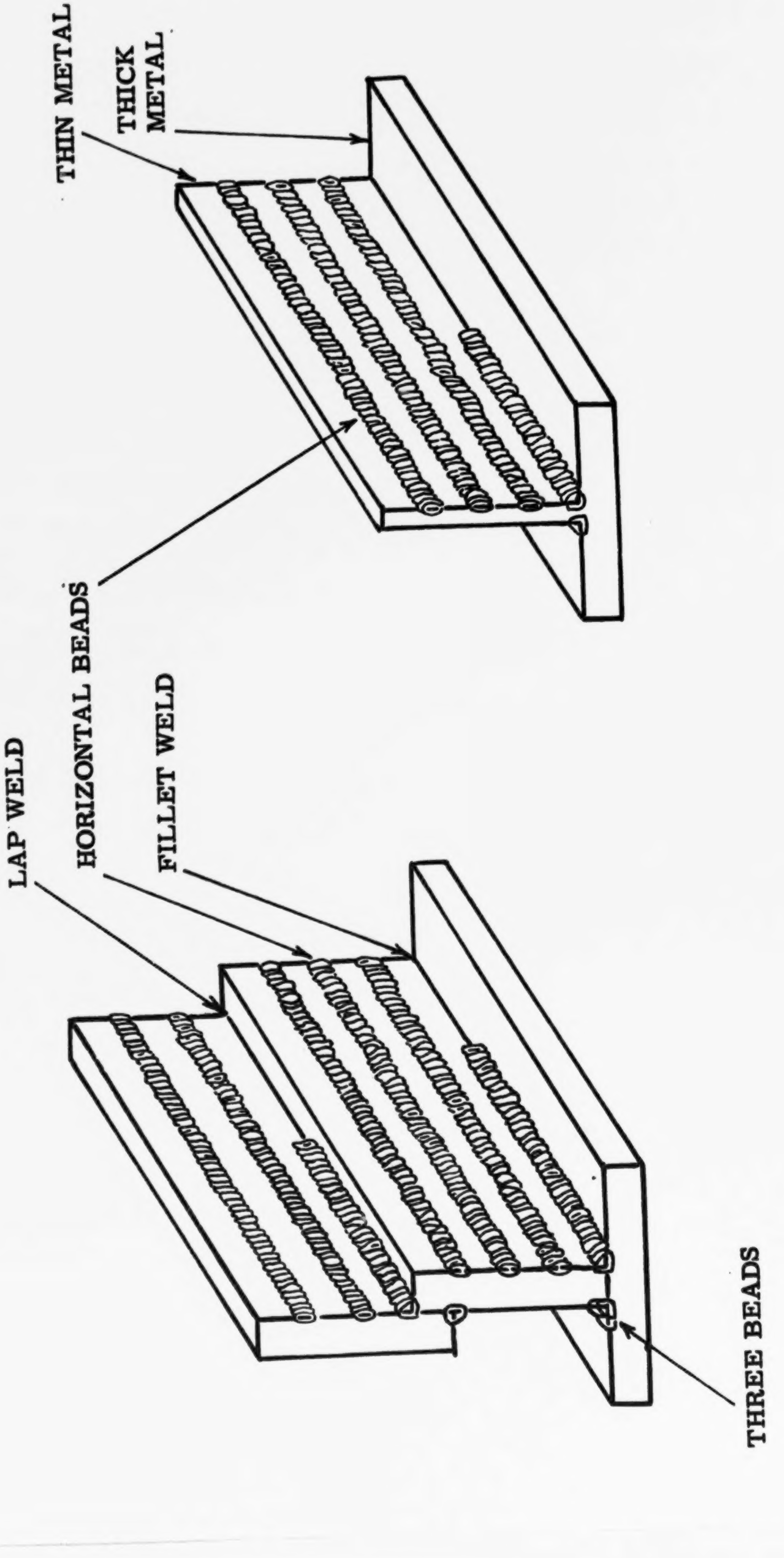
THINGS TO REMEMBER:

1. When welding pieces of unequal thickness, point electrode toward thicker piece.
2. Molten metal will stay in place better if you weld with a whipping motion on horizontal beads.

3. Hold electrode about 5 degrees below perpendicular and leading about 20 degrees in direction of travel on horizontal beads.

4. Clean work with chipping hammer and wire brush before turning it in for grading.

Fillet Welding in Horizontal and Flat Position


LAP WELD
HORIZONTAL BEADS
FILLET WELD
THREE BEADS
HORIZONTAL BEADS
THIN METAL
THICK METAL

Subunit: Arc Welding

Shop Exercise: Arc Welding Projects

OBJECTIVES:

To apply the knowledge and skill of this subunit in Arc Welding.

REFERENCES:

Drawing of Drawbar pin or Post Driver on next two pages.

SHOP TIME:

One Period.

PRACTICE MATERIAL:

Precut the bill of materials for the students so that they may utilize their time in welding.

ELECTRODE:

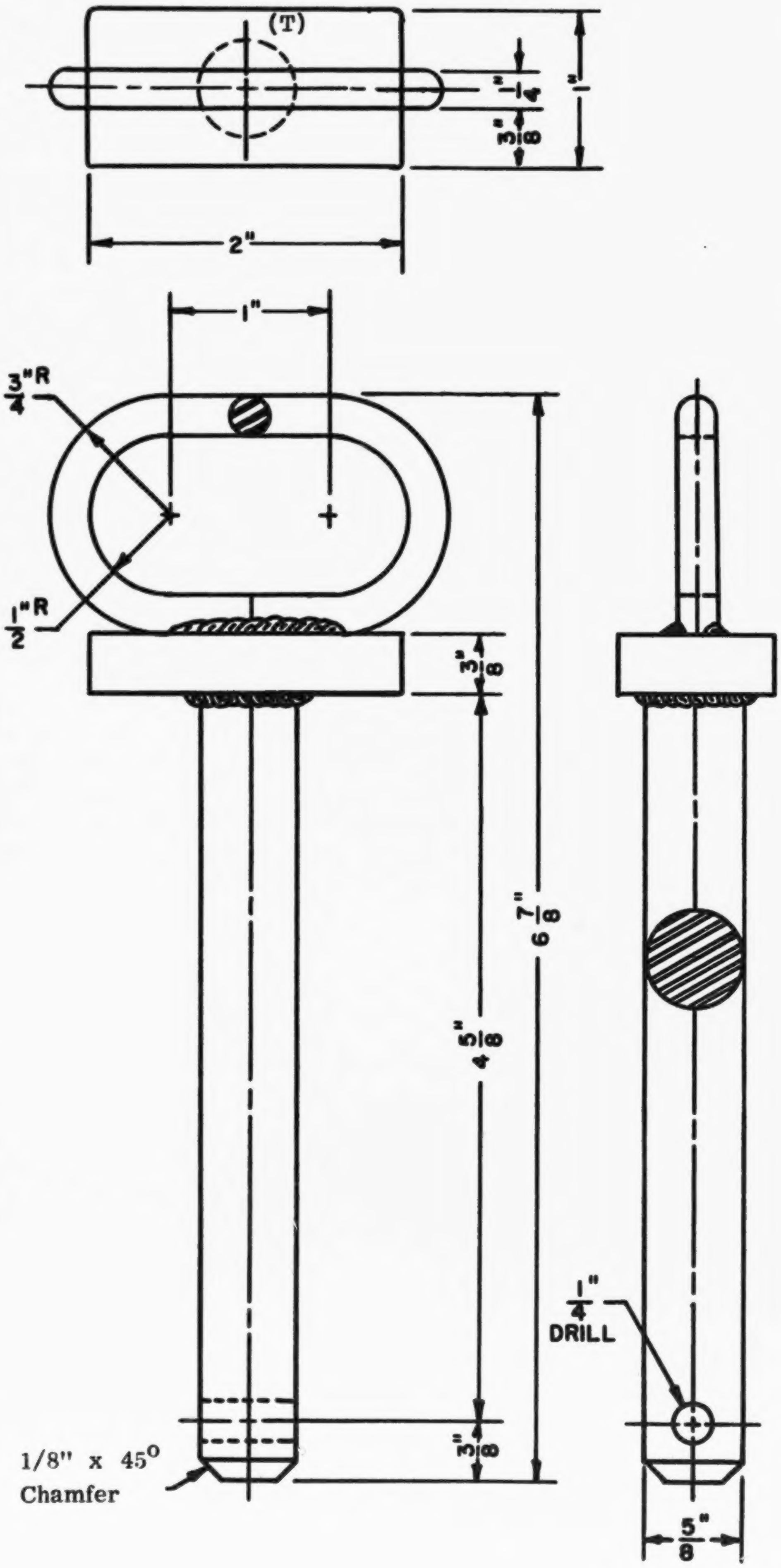
1/8" AWS, E6011.

AMPERAGE SETTING:

90 to 100 Amps.

PROCEDURE:

Follow the procedure and suggestions accompanying the drawings.



Agricultural Mechanics I

DRAWBAR PIN

Bill of Material:

1 pc mild steel 3/4" round 5" long
1 pc bar 3/8" x 1" x 2" long
1 pc rod 1/4" x 6" long

Construction Procedure:

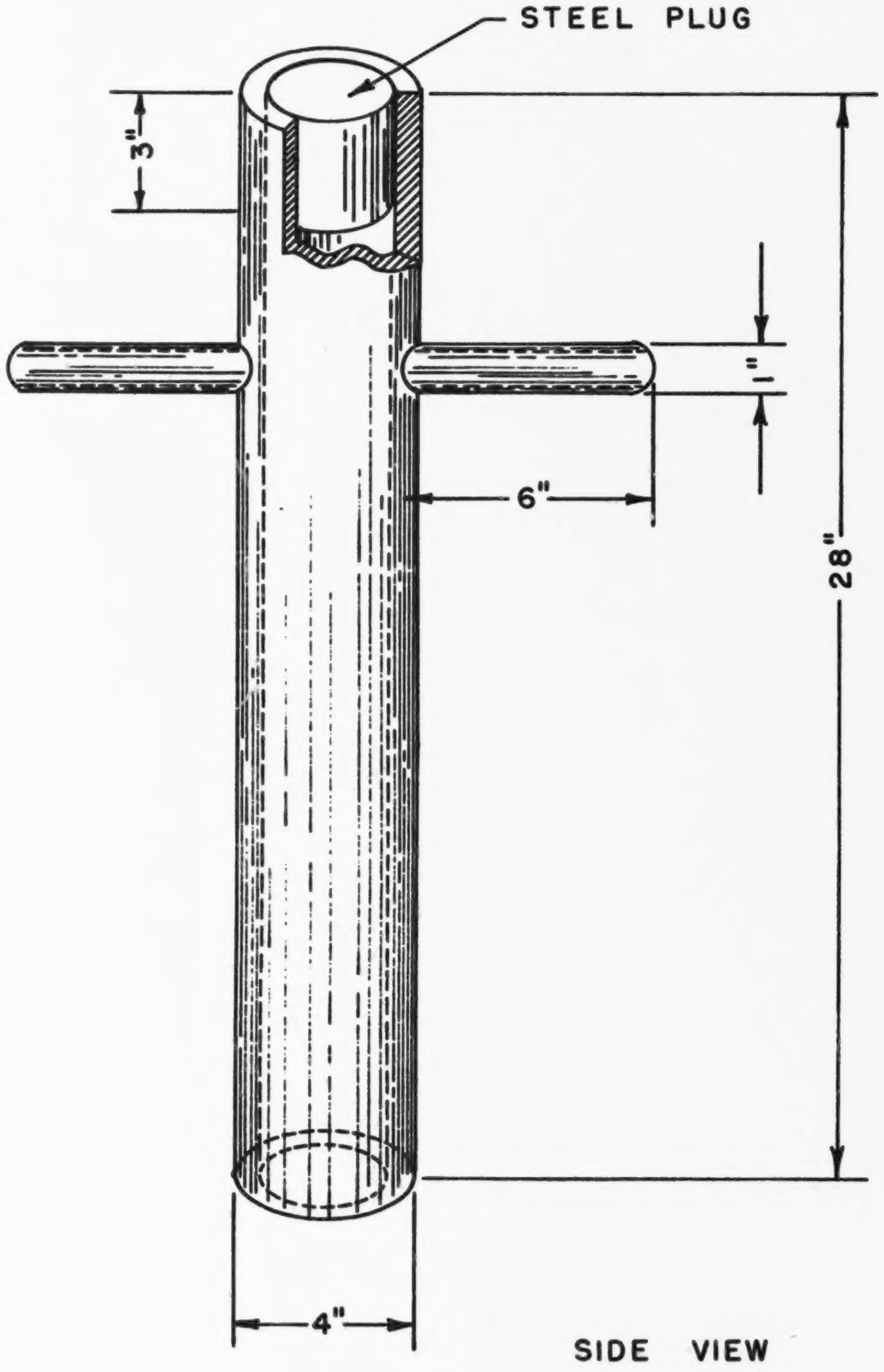
1. Cut top of pin to length.
2. Cut pin to length.
3. Drill 1/4" hole in bottom of pin.
4. Cut and shape handle of pin.
5. Weld pieces together to make pin.
6. Grind off rough part of weld and end of pin.
7. Paint using metal paint.

Suggestions:

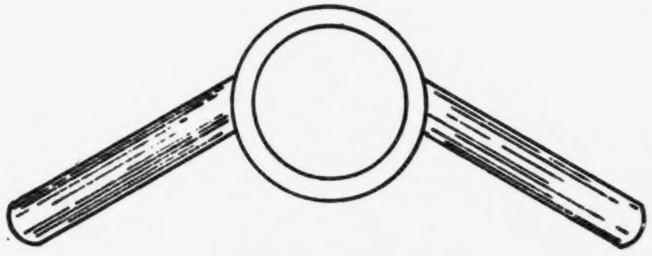
1. Bend handle cold using a vise and a 3/4" pipe as an aid for bending.
2. To get handle welded in center of pin, lay pin flat on welding table. Then place a piece of 3/8" flat metal under handle to act as a holding jig while welding.

Drawbar Pin
Scale: 12" = 1'-0"
Date: 6 July 1964
Drawn by: Dale Pontius
Mo. Agr. Ed. Plan No. 800

POST DRIVER



SIDE VIEW



TOP VIEW

Bill of Material

1 - 4" x 28" black pipe
2 - 1" x 6" black pipe for handles
1 - 4" x 3" plug

Construction Procedure

1. Construct plug by using pipes of smaller sizes and weld both ends solid.
2. Cut handles to set at an angle and weld in place.
3. Weld end solid which receives the 4" plug.
4. Paint with rust inhibiting paint and finish with an enamel paint.

POST DRIVER
SCALE - $\frac{3}{16}$ = 1"
DATE - 16 MARCH 1966
USED - COURTESY - C. WESTON
DRAWN & TRACED BY - B.W.
PLAN NUMBER - 801

Subunit: Gas Engines

Lesson: Principles of Engine Operation.

OBJECTIVE:

To teach the student the basic principles of engine operation. To teach the students to understand the various terms relative to engines.

REFERENCES:

All About Small Gas Engines, pages 16-30.

MOTIVATION:

Imagine your farm at home with no internal combustion engines. How many think they understand how an engine works? How often do they need some kind of attention? How many know how to do all the maintenance they need?

STUDY OR DISCUSSION QUESTIONS:

1. Make a list of internal combustion engines you have at home.
2. Why is a steam engine or turbine not an internal combustion engine?
3. When was the first successful internal combustion engine made?
4. How can the burning of gasoline in an engine create a force?
5. What are the main parts necessary to internal combustion engines?
6. What are the three main kinds of internal combustion engines?
7. What are the differences between the 3 kinds?
8. For what is each kind most generally used?
9. What sequence of events is necessary in any internal combustion engine?

SUMMARY OF INFORMATION:

1. Make a class survey list on the board to determine kind, sizes, and types most common.

2. The combustion takes place outside the working parts and is transferred in while in the internal combustion engine the working parts move as a direct result of the force created.

3. a) In 1680 Huygens of Holland tried to make an engine run on gun powder but was unsuccessful.

   b) 1860 - Etienne Lenoir of France made the first successful model.

   c) 1862 - DeRochas of France set forth principles of the 4-stroke cycle.

   d) 1876 - Otto of Germany made the first successful 4-stroke cycle engine. It burned illuminating oil.

   e) 1885 - A carburetor was developed so that gasoline could be used.

4. When the combustion takes place expansion always results.

5. Pistons, crankshaft, carburetor, valves, cylinder block.

6. Two-stroke cycle and four-stroke cycle and diesel.

7. Two-stroke - fires every time the piston comes up, less working parts. Four stroke - fires every other time the piston comes up, requires valves and a camshaft. Diesel - burns low grade fuel, doesn't use a spark plug ignition system.

8. Two-stroke cycle - small equipment, chainsaws, boat motors, lawnmowers. Four-stroke cycle - tractors, trucks, cars, lawnmowers. Diesel - tractors and trucks. Large equipment.

9. a) Fill the cylinder with an explosive mixture.

   b) Compress this mixture into a smaller space.

   c) Ignite the mixture or cause it to explode.

   d) Utilized the explosive or expansive force for power production.

   e) Remove the burned out mixture from the cylinder.

Subunit: Gas Engines

Lesson: Carburetion

OBJECTIVES:

1. To teach the student the basic function of the carburetor.
2. To explain the fuel air mixture.

REFERENCES:

All About Small Gas Engines, pages 137-151; *General Theories of Operation*, pages 10-19.

MOTIVATION:

Why not just put gasoline directly into the cylinder?
Why have a 4-barrel carburetor instead of one large one?

STUDY OR DISCUSSION QUESTIONS:

1. What is the basic purpose of the carburetor?
2. What is a venturi?
3. What is an airfoil?
4. In what ways may gasoline get into the carburetor?
5. What does the carburetor float do?
6. Explain how the fuel goes from the carburetor into the cylinder.
7. What is the ideal combustion mixture of air and gasoline?

SUMMARY OF INFORMATION:

1. To vaporize the gasoline and mix it with air.
2. A narrow area through which air must flow. It causes an increase in speed and a decrease in pressure of the air.
3. A tube in a stream of air inside the venturi which creates an air pattern with low pressure on one side.
4. Gravity feed, fuel pump, suction of the carburetor.
5. Regulates the amount of fuel in the bowl of the carburetor.

6. As the engine is turned over, the intake stroke creates a suction in the manifold and through the carburetor. Air rushes in through the venturi. Gasoline is already in the nozzle located in the venturi. As the low air pressure is produced on the backside by the airfoil the fuel comes through little holes and is mixed with the air rushing into the manifold.

7. 14 to 15 lbs. of air to 1 pound of gasoline.

TEACHING SUGGESTIONS:

Use Briggs and Stratton, General Theories of Operation, as an additional reference on carburetion.

Subunit: Gas Engines

Lesson: Two stroke Cycle Engines

OBJECTIVE:

To teach the theory of the 2-stroke cycle engines and to acquaint the students with the parts of the 2-stroke cycle engine.

REFERENCES:

All About Small Gas Engines, pages 12-17.

MOTIVATION:

Why are chainsaws, boat motors, 2-stroke cycle? How many could recognize a 2-stroke cycle engine by observing the external structure? How many could recognize it if it were taken apart?

STUDY OR DISCUSSION QUESTIONS:

1. What is ment by the term "2-stroke cycle"?
2. What are the advantages of this type?
3. What are the disadvantages?
4. Explain what takes place during one cycle of the engine.
5. What keeps the incoming gases from going out the exhaust when it is at the bottom of the stroke?
6. Does a 2-stroke cycle engine need a carburetor? A spark plug? A valve? A camshaft assembly?
7. Make a diagram of a 2-stroke cycle engine near the top of the stroke going up. Label parts and explain.

SUMMARY OF INFORMATION:

1. It fires after 2 strokes. In other works, fuel injection, exhaustion, compression, and ignition all take place in 2 strokes so that it fires every time the piston comes to the top.
2. More power per pound. Less working parts, less expensive to buy, and less vibration on a single cylinder engine.

3. Fuel mixture is controlled with some difficulty; power and speed are difficult to control; cooling and lubrication are difficult; less efficient and somewhat harder to start.

4. Use a mock-up engine or a cutaway model to show 2-cycle principle. On the upward stroke, gasoline vapor is pulled into the crankcase and the mixture in the cylinder is compressed. Just before top dead center ignition takes place. On the downward stroke, gases in the crankcase are compressed. At a point near the bottom the exhaust port is open. A little later the intake port from the crankcase is open. The gasoline-air mixture rushes in from the crankcase and waste gases go out the exhaust port.

5. There is a deflector on top of the piston.

6. Carburetor - yes. Spark plug - yes. Valve assembly - no.

7. Two Cycle Engine Operation.

TEACHING SUGGESTIONS:

Use a cutaway engine or a wooden mock-up of a 2-cycle engine. Use charts. Use a piston to show the deflector.

Subunit: Gas Engines

Lesson: Four-stroke Cycle Engines

OBJECTIVE:

To teach the theory of four-cycle engine operation.

REFERENCES:

All About Small Gas Engines, pages 12-15; General Theories of Operation, pages 3-7.

MOTIVATION:

What type of internal combustion engines do most cars have? Why?

STUDY OR DISCUSSION QUESTIONS:

1. What is meant by the term "4-stroke cycle"?
2. What are the advantages of the 4-stroke cycle?
3. What are the disadvantages?
4. Make 4 drawings, each indicating what takes place during each stroke in the complete cycle and explain.
5. What is another name for the 4-stroke cycle?
6. Does a 4-stroke cycle engine need a carburetor? A spark plug? A valve and camshaft assembly?

SUMMARY OF INFORMATION:

1. The piston makes 4 strokes: 2 up and 2 down to accomplish all phases necessary for combustion power.
2. Lasts longer. Greater efficiency of fuel. Better lubrication.
3. Heavier per horsepower. More working parts to go wrong.
4. Show transparency on 4-cycle engine operation.
5. Otto cycle, named after the inventor.
6. Carburetor - yes. Spark plug - yes. Valve assembly - yes.

TEACHING SUGGESTIONS:

Use a cutaway or a wooden mock-up of a single cylinder 4-stroke cycle engine. Use Briggs and Stratton charts.

Subunit: Gas Engines

Lesson: Disassemble and Reassemble a Gas Engine

OBJECTIVE:

To teach the student the proper disassembly procedure. To teach the student what to look for in disassembly that might have been wrong with the engine. To teach the student how to reassemble the engine.

REFERENCES:

Repair Instruction II

MOTIVATION:

How should a small engine be disassembled? What parts should be checked for wear? What procedure is followed when putting the engine back together?

DEMONSTRATION:

Follow the disassembly procedure in Briggs and Stratton "Repair Instruction II".

STEPS IN DISASSEMBLY AND CHECKING:

1. Drain oil.
2. Remove the air cleaner and the stud and any other parts of the engine that are made of plastic. Steam or solvent deteriorates plastic.
3. Drain fuel tank.
4. Remove blower housing.
5. Clean the engine with steam or solvent (cover the coil as solvent or steam might damage it).
6. Disassemble and check starter mechanism.
7. Spin flywheel to check compression.
8. Check spark.
9. Check air gap.
10. Check governor blade for wear.
11. Remove valve cover and check valve clearance.

12. Remove cylinder head bolts, indicate where long bolts belong, demonstrate threading and removal of stud that has been twisted off.

13. Remove vlaves and springs (point out different kinds of valve keeper and how they are removed).

14. Inspect valves and seats.

15. Check valve guides.

16. Remove starter pulley or starter clutch.

17. Remove flywheel. Demonstrate how to remove with Briggs and Stratton puller and removing the flywheel by striking the crankshaft sharply with a plastic mallet, while lifting on the flywheel.

18. Check flywheel key.

19. Remove breaker point cover (indicate the use of a sealer where the coil wire enters).

20. Check breaker point gap.

21. Remove condenser and points.

22. Check breaker point plunger and plunger hole.

23. Test condenser.

24. Test coil.

25. Check crankshaft end play.

26. Remove burrs from crankshaft extension and use emery paper to remove all rust so that bearing will not be distorted.

27. Remove base or sump.

28. Remove oil slinger.

29. Remove and check cam gear. (Emphasize timing marks. If they cannot be found use a punch to make the timing marks).

30. Remove and check tappets.

31. Ream ridge from top of cylinder.

32. Remove and check piston and rod.

33. Remove and check crankshaft.

34. Check cylinder bore.

35. Check main bearings.

36. Check condition of all threads and bolts. Remove any studs that have been twisted off and thread or use insert thread to restore original condition.

REASSEMBLY:

1. Insert tappets, crankshaft, and cam gear (lubricate all parts).
2. Assemble piston and connecting rod and install.
3. Secure oil slinger and install sump. Adjust the crankshaft end play.
4. Set valve clearance.
5. Replace valve assembly.
6. Assemble coil, governor blade and ignition cable.
7. Install points and condenser.
8. Adjust points.
9. Install breaker point cover, seal wires with gasket sealer.
10. Install flywheel.
11. Adjust air gap.
12. Check ignition by checking spark.
13. Install air cleaner.
14. Place cylinder head and gasket in place and tighten to proper torque.
15. Install spark plug.
16. Tighten muffler if it has been removed.
17. Assemble carburetor and linkage.
18. Install governor.
19. Install blower housing.

20. Connect fuel lines.
21. Fill crankcase with oil.
22. Fill gas tank.
23. Start engine.
24. Retorque head.
25. Make fine adjustments on carburetor and governor.
26. Fill air cleaner.
27. Paint engine.
28. Apply decals.

Subunit: Gas Engine

Shop Exercise: Disassemble and reassamble a Gas Engine

OBJECTIVES:

To apply the knowledge learned in the gas engines subunit. To develop a skill in assembling and disassembling small engines. To learn how to make minor repairs and adjustments on small engines.

REFERENCES:

Repair Instruction II

SHOP TIME:

7 Periods.

MATERIALS NEEDED:

Briggs & Stratton tools, small engine for each student, hand tools,"Repair Instruction II"manuals.

PROCEDURE:

Follow the disassembly steps in Briggs & Stratton "Repair Instruction II," make adjustments according to the steps, and reassemble according to the assembly steps.

Subunit: Farm Service Center

Lesson: Planning a Home Farm Service Center.

OBJECTIVE:

To make students aware of the value of a home farm shop. To encourage the establishment of a home farm shop.

REFERENCES:

Shopwork on the Farm, pages 1-19; The Farm Shop, pages 25-41.

MOTIVATION:

Many times the establishment of a farm shop has meant the difference between profit and loss in a farm business.

STUDY OR DISCUSSION QUESTIONS:

1. How large should a farm shop be?
2. How should the shop be wired?
3. How should tools and equipment be stored and cared for?
4. What provisions should be made for fire protection?
5. How should tractor fuel be stored? Where should fuel and lubricants be located according to the National Fire Protection Association?
6. List the safety practices that should be followed in the shop with respect to equipment.

SUMMARY OF INFORMATION:

1. A floor space of about 14 by 20 feet is usually adequate. For complete repair services larger spaces are required.
2. The shop should be wired for a generous use of electricity. Good lights to encourage shop work on rainy dark days when outside work cannot be done. It is advisable to install a 60-ampere service entrance with at least four branch circuits. A separate 230-volt circuit with heavy wiring for an electric welder should be included.
3. The interior of the shop should be arranged for storing tools. Tool cabinets and tool boards should be provided. A systematic and orderly storage of supplies and materials, as well as of tools, contributes a great deal to the value and usefulness of a shop.

4. One should ventilate the shop to avoid concentration of inflammable fumes. Only small quantities of gasoline should be kept in the shop and it should be in a tight metal container. Oily rags should not be allowed to accumulate and should be stored in a metal container. There should be at least one fire extinguisher in an easily accessible place. Numerous pails or boxes of sand should be kept in the shop to extinguish oil fires.

5. The National Fire Protection Association states that fuel in containers of 60 gal. or less may be stored inside a building if it is used only for storing flammable liquids and is located at least 40 ft. from other buildings. Tractor fuel in quantity should be stored 40 ft. from other buildings.

6. Practice good shop housekeeping. Protect yourself against injury, keep tools in good condition and wear goggles when grinding. Keep guards over belts, pulleys, gears, etc. Guard against fumes, avoid fire hazards.

Subunit: Painting

Lesson: Painting and Care of Brushes

OBJECTIVES:

To teach students to prepare wood surfaces for painting. To teach students how to select paint. To teach students how to paint and how to care for paint brushes.

REFERENCES:

Shopwork on the Farm, pages 183-199; The Farm Shop, pages 340-356.

MOTIVATION:

Painting prolongs the serviceable life of materials, improves appearance, and on the inside of buildings, promotes cleanliness and sanitation.

STUDY OR DISCUSSION QUESTIONS:

1. What is paint composed of?
2. What are some of the troubles and failures of painted surfaces?
3. How much area will a gallon of paint cover? How do you figure the area the paint will cover?
4. How should wood surfaces be prepared for painting?
5. What temperature is best for painting?
6. How should paint be thinned and mixed?
7. What procedure should be used when painting with a brush?
8. How should brushes be selected?
9. How should brushes be cleaned when finished painting?

SUMMARY OF INFORMATION:

1. Pigment and vehicle.
2. Alligatoring, blistering and peeling, checking, cracking and scaling, running and sagging, wrinkling.
3. Under average conditions, one gallon of outside house paint will cover about 600 sq. ft. on the first coat, 700 on the second and third coats. To estimate the amount of paint required for a job, determine the

number of square feet a gallon of paint will cover; then divide this figure into total number of square feet of surface to be painted.

4. Surface to be painted should be dry and clean, free from mud, dust, grease, plaster, smoke, rust, or old, loose, scaly paint.

5. Painting should be done at temperatures between 65 and 80 degrees. One should not paint when the temperature is below 50 degrees.

6. Directions for thinning are printed on the label; these directions should be followed very carefully. Paint should be thoroughly mixed. Stirring should begin first and continue until the pigment becomes a paste; then add thinners by pouring while continually mixing. Five gallons of paint often requires more than one half hour of mixing.

7. Hold the brush lightly with the long part of the handle resting in the hollow between the thumb and first finger and with the ends of the fingers up the handle toward the ferrule. Dip the brush into the paint about one third the length of the bristles, remove excess paint by gently raking the brush against the side of the pail. Brush with long sweeping strokes. Feather the strokes by bringing the brush down against the surface gradually at the beginning of each stroke and lifting it gradually.

8. A 3½ or 4-inch brush is commonly used for painting large surfaces. The bristles should not be too long, not much over 4 inches for inexperienced painters. Smaller brushes should be used for trim.

9. Never allow a brush to rest upright on its bristles. Suspend the brush in a can of turpentine and raw linseed oil if work is stopped overnight. Clean the brush thoroughly with turpentine, benzine, gasoline, or kerosene, and wash it with warm soapsuds. Shake the brush well, wrap it in heavy paper.

TEACHING SUGGESTIONS:

Demonstrate proper painting technique.

Subunit: Tool Sharpening

Lesson: Sharpening the Plane Bit and Wood Chisel

OBJECTIVE:

To teach students how to correctly sharpen the plane bit. To teach students how to correctly sharpen the wood chisel.

REFERENCES:

Shopwork on the Farm, pp 213-220; The Farm Shop, pp 53-56.

MOTIVATION:

If a tool is properly used and cared for, it can be resharpened several times on an oilstone before it will need to be ground.

DEMONSTRATION:

Always wear goggles when using grinding wheel.

1. Checking angle and shape of cutting edge.
    a. Grind plane bits and wood chisels at an angle of about 25 to 30 degrees.
    b. Grind bevel straight or slightly concave.
2. Grinding plane bits and wood chisels.
    a. Hold the tool against the grinding wheel in a manner that will produce a smooth, even bevel.
    b. Adjust the work rest so tool when held firmly against the rest will come into contact with wheel at the desired angle.
    c. Grasp the tool so that the first finger will align the bit against the work rest.
    d. Turn wheel toward cutting edge.
    e. Hold the tool against the wheel with medium pressure.
    f. Move the tool from side to side across wheel.
    g. Cool tool frequently.
    h. Inspect work often.

3. Whetting a plane bit or wood chisel.
    a. Place a few drops of oil on the coarse side of the stone.
    b. Keep the bevel of the tool flat on the stone.
    c. Push tool forward and bear down on forward stroke.
    d. Remove wire edge on fine side of stone.
    e. A few strokes on the stone on the flat side of the bit will remove the wire edge.
4. Stropping a plane bit or wood chisel.
    a. A few drawing or pulling strokes with the cutting edge trailing on a smooth leather after sharpening on the oilstone gives a keener edge.
    b. Check the bit by the shaving test, or by feel.

Subunit: Tool Sharpening

Lesson: Sharpening the Knife

OBJECTIVE:

To teach student to sharpen a knife safely and correctly.

REFERENCES:

Shopwork on the Farm, pages 206-212; The Farm Shop, pages 65-66.

MOTIVATION:

How can a knife be sharpened so that it will shave?

DEMONSTRATION:

Always wear goggles when using the grinding wheel.

1. Grinding a knife
    - a. Place point higher than the handle and flat against the wheel.
    - b. Move the blade slowly back and forth at an angle across the wheel.
    - c. Be careful not to overheat the blade; dip in water often.
    - d. Check often, grind to desired shape.
2. Whetting
    - a. Place a few drops of oil on oilstone.
    - b. Draw the knife across the stone diagonally, keep the heel of the blade against the stone at the beginning of the stroke.
    - c. Turn blade over and use same procedure as in b.
    - d. Use fine stone when a wire edge is produced in same manner as coarse stone.

3. Stropping
    a. Strop the knife on a piece of smooth leather.
    b. Use pulling strokes with the cutting edge trailing.
4. Test knife for sharpness
    a. Feel the blade with the thumb.
    b. Shaving test.
    c. Look at edge in light for nicks, dull spots.

Subunit: Tool Sharpening

Lesson: Sharpening the Auger bit

OBJECTIVE:

To teach students how to sharpen an auger bit.

REFERENCES:

Shopwork on the Farm, pp223; The Farm Shop, p. 53, Transparency, "Sharpening an Auger Bit" Auger bit, auger bit file, 3-corner file.

MOTIVATION:

How do you sharpen an auger bit? How do you tell when it is sharp?

DEMONSTRATION:

1. Sharpen Spurs
    a. Place the auger bit on the edge of a table.
    b. File the spur that is to the left of the feed screw.
    c. Rotate the auger bit one half turn and file the other spur.
    d. Smooth edge of the file is placed next to the cutting lip to prevent filing the bottom edge of the cutting lip.
    e. The outsides of the spurs are not filed unless the edges have been damaged. Never file the tips of the spurs smaller than the auger bit diameter.
2. Cutting Lips
    a. Place the auger bit on table top.
    b. File the top of the cutting lip on the right of the feed screw.
    c. Rotate the auger bit one-half turn and file the cutting lip.
    d. Bottoms of the cutting lips are not filed.

   e. In filing the cutting lips, place the smooth edge of the file next to the core of the bit to prevent damaging the core.

   f. Both cutting lips should be filed the same amount so they will cut evenly.

3. Feed Screw

   a. The feed screw does not require sharpening.

   b. If threads are damaged they can be improved by filing with a slim, tapered triangular file.

REMEMBER:

1. **File the spurs on the inside.**
2. **File the cutting lips on the top side.**
3. **Keep the original bevel on the cutting lips.**
4. **Remove the same amount of material from each side.**

Sharpening an Auger Bit